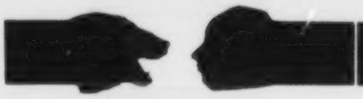

Bear-People Conflicts

PROCEEDINGS OF A SYMPOSIUM ON MANAGEMENT STRATEGIES

Northwest Territories Department of Renewable Resources
1989

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BEAR-PEOPLE CONFLICTS: PROCEEDINGS OF A SYMPOSIUM ON MANAGEMENT STRATEGIES

Northwest Territories Renewable Resources
The Honourable Titus Allooloo, Minister

BEAR-PEOPLE CONFLICTS: PROCEEDINGS OF A SYMPOSIUM ON MANAGEMENT STRATEGIES

SYMPOSIUM HELD 6 - 10 APRIL, 1987
YELLOWKNIFE, NORTHWEST TERRITORIES
CANADA

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Symposium Co-Chairmen: Paul A. Gray and Peter L. Clarkson
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PREFACE

The management of bear-people conflicts is a difficult and serious problem confronting governments, industry, and the public in many countries. This conflict is a result of people's continued expansion into bear habitat, and the corresponding pressures of urbanization, recreation, and industrial exploration and development. It is a serious problem because it can potentially result in the loss of critical bear habitat, the loss of bears, and increased risk to people living and working in bear habitat. And as the number of people living and working in bear habitat increases, so does the need to develop and implement effective proactive management programs designed to eliminate or significantly reduce bear-people conflict.

A considerable amount of research has been completed on bear-people interaction with the goal of developing effective and practical strategies to manage people and bears. In addition, training and education programs designed to assist people in their efforts to prevent and/or effectively manage problems are being implemented by a number of agencies and companies.

This Symposium was designed to facilitate the exchange of information about bear-people conflict management now being applied, designed, and/or tested. The Proceedings contain papers on the behaviour and ecology of problem bears, bear detection and deterrent techniques, problem bear management programs, and public education and the media. In addition, the results of panel discussions on interjurisdictional problem bear management, and the future direction of problem bear research and management, are described. The results of 2 workshops, which focused on problem bear management and planning, and techniques to deter, capture, and handle problem bears are also included in this document.

We feel comfortable in stating that the Symposium facilitated significant and meaningful discussion and debate, and we applaud all of the participants for their interest and dedication to this complex and emotionally charged subject. The papers in these Proceedings are testimony to the professional expertise of those who concern themselves with this subject, and who made the Symposium so successful. Our hope is that this collection of papers and thoughts will be used to further advance our understanding of bears, people, and the way in which they interact. These papers will likely result in the identification of more questions than answers. This is good. We hope that they will serve as catalysts for significant new advances.

Finally, we would like to issue a challenge. We feel a Symposium of this kind would benefit all those concerned with bear-people interaction, and recommend that a Symposium be held every 3-5 years. We look forward to attending the next one, wherever it may be.

PAUL A. GRAY
CO-CHAIRMAN

PETER L. CLARKSON
CO-CHAIRMAN

ACKNOWLEDGEMENTS

To organize and conduct a symposium that brings together people and ideas from several nations requires the assistance and support of many people. The cooperation received from everyone was greatly appreciated. The following representatives of the Department of Renewable Resources, Government of the Northwest Territories contributed to the success of the symposium: the Honourable Red Pedersen, Minister of Renewable Resources (1987); James Bourque, Deputy Minister; David Brackett, Assistant Deputy Minister; Robert Bell, Director, Wildlife Management Division (1987); Kevin Lloyd, Director, Wildlife Management Division; Edward Hall and Terry Woolf, Conservation Education/Resource Development Division; Sinni Tong, Jackie Bell, Steve Moore and Paul Panegyuk, Habitat Management Section.

Yvonne Lynn and staff, Culture and Communications Department; Ronne Hemming and staff, Outcrop Ltd., assisted in production of information brochures for the symposium.

On occasion, one encounters a few rare individuals who have considerable knowledge and expertise about a particular subject and who always willingly share this knowledge and expertise in hope that it will benefit the resource. Dr. Ian Stirling, Canadian Wildlife Service and Dr. Stephen Herrero, University of Calgary, are two such individuals. Our sincere thanks go to both of these fine scientists who were always there to answer questions.

During the symposium assistance was received from Session and Panel Chairmen, Andy Russell, L. Ronald Quaife, Ian Stirling, Stephen Herrero, Kevin Lloyd and Mitchell Taylor. Dr. Fred Bunnell, University of British Columbia, did an admirable job as Symposium Rapporteur.

During any symposium the role of coordinating all of the people, times and places is an immense job. The keen interest, dedication and superior organization skills of Mika Sutherland, Symposium Coordinator, made the symposium enjoyable and successful.

The Explorer Hotel and staff are to be congratulated for supplying a comfortable and friendly atmosphere in which to hold the symposium.

Finally, a special thanks to all symposium participants who with keen interest in bear-people conflicts travelled many miles and brought with them their ideas and experience that helped make the symposium a success.

PAUL A. GRAY
CO-CHAIRMAN

PETER L. CLARKSON
CO-CHAIRMAN

Publishing a proceedings is always a joint effort. Many thanks are due to the numerous reviewers, who provided comments that were helpful to the authors and the editor. Robert Ferguson's administrative, supervisory, and moral support was much appreciated. Mitchell Taylor was always available for consultation, and provided helpful explanations and advice. Sinni Tong's capable secretarial help was a blessing. Yvonne Lynn, Department of Culture and Communications, advised on design and handled the technical aspects of reproducing figures and printing. Donna-Lynne K. Smith and Cindy Peters spent countless hours on the word processor, dealing with all the details of typing and layout. John Lee and Aiko Sutherland provided invaluable help with proofing. And of course there are the authors - without their patience, continual cooperation, and professional work there would be no proceedings.

MARIANNE BROMLEY
EDITOR

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SECTION I. BEHAVIOUR AND ECOLOGY OF PROBLEM BEARS

CHAIRMAN: ANDY RUSSELL, Turner Valley, Alberta

BEHAVIOURAL PLASTICITY AND BEAR-HUMAN CONFLICTS

BARRIE K. GILBERT, Department of Fisheries and Wildlife, Utah State University, Logan, UT 84322-5210

Abstract: Increasing recreational activity in the range of bears, especially in national parks, is a threat to bear survival. The mere presence of people is capable of inducing losses of bears either through direct lethal conflict or displacement from essential habitat. This paper explores the influence of prior experience with people on the response of bears to people. Of particular significance, but poorly understood, is the sensitizing effect of hunting, handling or other stressful contacts with people which may result in increased energy costs and abandonment of high energy food sites. At the other extreme, human activities which facilitate habituation and conditioned approach to people by hungry bears will increase lethal risks to people and bears. Recognition of the importance of interactive effects of prior conditioning on response plasticity is fundamental to responsible management of bears.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Plasticity of behaviour refers to the capacity of wide phenotypic expression from narrower ontogenetic beginnings. The range of experiences and environments that influence the developmental path of organisms is extensive (Bateson 1982). Learning and conditioning processes are central to behavioural plasticity currently recognized in theoretical and empirical studies of carnivore behaviour and ecology (Lomnicki 1982, Kruuk and MacDonald 1985).

Plasticity or flexibility in mammalian behaviour parallels the evolution of large brains. Geist (1978) has discussed the trend toward large brains in mammals of periglacial and arctic ecosystems, especially carnivores. Among the carnivores the ursids have the highest brain:body weight (Gittleman 1986). Bears excel in foraging for energy-rich food resources; this is perhaps similar to correlations between brain size and feeding behaviour found in Chiroptera (Eisenberg and Wilson 1978). The brown/grizzly bears (*Ursus arctos*) exhibit a wide range of adaptability to habitats and foods; a similar plasticity characterizes their relationships with humans. The origins and maintenance of these varied responses to humans are the subject of this paper.

Although the focus here is on the causes of variation in the response of bears to humans, other behaviour patterns, such as fishing behaviour (Egbert 1978) and food selection (Pearson 1975) could also be compared. Bear-people interactions are significant because their increase has been recognized as posing a greater threat to bears than habitat modification (Knight 1977, Weaver et al. 1986). When the root causes of garbage-condition and destructive and aggressive behaviour are not addressed, bears are intentionally destroyed or otherwise removed from the population by private citizens or government agencies. Recent studies document deaths from handling, defence of life and property, and other human-caused reasons as the major factor limiting recovery of grizzly populations south of Canada. Until the primary causes of these undesirable behavioural changes are clarified by research, and addressed in management, techniques to modify behaviour (e.g., aversive conditioning) may only treat symptoms. If the food base is poor, instilling fear of people may impose higher energy costs and avoidance of richer, less secure, habitats.

Analysis of bear-people interactions is central to understanding bear depredation problems. As an organism-centered approach it is aligned with current ecology, especially ethological and behavioural ontogeny, in coming into the mainstream with population dynamics and ecosystem perspectives of wildlife ecologists. As an analytical approach it focuses on the behavioural and physiological mechanisms underlying population dynamics. Lomnicki (1982) and Jamieson (1986) have called for renewed attention to behavioural mechanisms for explaining how population regulation works.

Ethological and psychological concepts and mechanisms are central in models explaining the origin and maintenance of behavioural responses of bears to people. These models assist managers to predict the impacts of human activities on bears based on the prior history of bear-people contacts and current ecological variables. The aim of this paper is to develop models, based on comparisons of grizzly/brown bear populations with very different histories, to account for the behavioural plasticity observed in different geographic areas.

This analysis examines the hypothesis that the variation in bears' response to people is primarily influenced by learning and the transmission of those responses to offspring. While genetics prescribes the broad limits of behaviour, for example differences in aggressive behaviour between black and brown bears, it is evident that some bear populations have displayed the full range of responses to people either at different times in history or at the same time under different management regimes. As an example, the plasticity in accommodation to other brown bears and people on Alaskan salmon streams had its parallel among the garbage dump habitués at Yellowstone National Park. There is insufficient evidence to judge whether Rocky Mountain bears would be more social and presumably tolerant of people if raised with the abundance of food available to grizzlies on the coast of Alaska. In the absence of experimental studies we depend upon comparative approaches to see correlations and infer mechanisms, as in evolutionary questions (Clutton-Brock and Harvey 1978).

Comparative sources for this analysis are drawn largely from the brown bear literature. Additional sources include behavioural studies on black bears in Alberta (Gilbert and Roy 1977) and California (Hastings et al. 1987), polar bears in Manitoba, and our current research on brown bears in Alaska.

A final caveat: the experimental data required to critically evaluate the model do not exist. While the hypotheses are consistent with existing data, a level of certainty attainable with experimental tests is not claimed.

The Role of Prior Experiences in Determining Bear Behaviour

The response of bears to people, vehicles, aircraft, etc. has been considered highly variable, both within populations and between different geographic areas. Commonly the differences in behaviour are attributed to "individual variation" which, if reflected upon, is not an explanation but a descriptive restatement of the facts. While small individual differences in response to disturbances no doubt exist, a more global source of variation is the experience of individual grizzlies and their history of interactions with people. How do these different histories influence later contacts with people?

Prior experience of grizzly bears with people may be classified broadly according to whether the interaction had negative, neutral or positive consequences for the bear (Figure 1). For example, when a bear is injured by a person (negative reinforcement), the effect of a subsequent capture will have a greater impact than if the bear had not associated humans with painful experiences (Quimby 1974, Pearson 1975, Harding and Nagy 1980). I will compare the response to live-capture of bears with different prior histories.

Comparing responses to live-capture has the advantage of using a relatively standard procedure carried out widely by biologists who can report objectively on its effects on the bears. Limitations include a lack of quantitative measures and the risk of over-generalization about the normative history of the bears' relationship with people.

The Influence of Prior Negative Interactions With People on Capture Impacts

Grizzly bears, and other large mammals, avoid areas near people after being harassed, hurt, or injured. There are processes other than direct association of people with negative or aversive stimuli by which bears can learn to avoid humans. For example, cubs can learn to fear people by observing their mother's behaviour. They may be timid or subordinate to people for various reasons. Whatever the mechanisms, the relevant point is that prior painful experiences with people, especially hunting, can make grizzly bears especially sensitive to human presence.

The consequences of these interactions are diagrammed (Figure 1). Bears having previous negative experience with people can be expected to show fear when captured, suffer higher stress, and respond more aggressively when approached while snared. It may be

REINFORCEMENT SYSTEM	HISTORY OF BEAR-HUMAN INTERACTIONS ⇒	BEHAVIOURAL EFFECTS ⇒	BIOENERGETIC EFFECTS ⇒	POPULATION EFFECTS
NEGATIVE	**Negative** ⇒ - hunted - captured, hurt - "natural" avoidance	**Aversive Conditioning** ⇒ - strong avoidance - increased aggressiveness	**Increased Cost** ⇒ - disturbed feeding, - abandon prime habitat - increased activity	**Decline** - nutritional stress reduces recruitment
NEUTRAL	**Habituated** ⇒ - frequent contact - tolerate people at close range	**Minimum Response** ⇒ - minor avoidance - possible aggressive food-seeking in low quality habitat	**Negligible** - normal foraging - seek people's food if forage low	**Minimal** - natural process predominate
POSITIVE	**Garbage-Conditioned** ⇒ - tolerate people - aggressive food-seeking potential	**Further Conditioning** ⇒ - "trap happy" - reduced fear of artifacts - increased aggressiveness	**Increased Food Base** - orients more to people's food	**Increased Mortality** - removed when a threat - high mortality as natural food declines

Figure 1. Effects of live capture on grizzly bears based on history of bear-human interactions (hypothesized).

that the most cautious bears avoid trap sites altogether or outwit the trapper by removing or burying the snare (Pearson 1975).

The combination of capture and earlier negative associations with people may affect the feeding efficiencies of these bears (upper row, Figure 1). At feeding sites visited by people these bears will cease feeding and seek cover. Frequent interruptions may result in abandonment of prime habitat (Gunther and Renkin 1985). Even if alternate sites are available the increased costs of movement will increase nutritional stress. Nutritional deficits translate into reduced recruitment in bear populations.

There are a few situations where negative reinforcement or punishment of bears is useful in promoting bear conservation. Hitting bears with rubber shot and slugs has been used selectively to teach bears not to approach camps or people too closely (Aumiller 1984, Jope 1986). These techniques may be critical in changing the behaviour of young bears exploring human food sources for the first time. If the behaviour can be modified early enough, a bear which would end up being shot for destructive behaviour may avoid human odours and return to wild foods.

Where such aversive conditioning techniques are proposed, the situation should be carefully evaluated. If a population of bears is exposed to considerable human disturbance, and the bears are already highly sensitized to people, additional stress may have significant impacts on the population. Improvements in the food base and better security (refuges) for the bears may be more fundamental solutions.

The Influence of Habituation to People on Capture Impacts

Habituation is defined as a reduction in the frequency of a response when no consequence is perceived by the animal. Avoidance or fear responses of wildlife fade when the stimulus causing the response is not followed by a threat, pain, or injury. Thus grizzly bears on salmon streams that are not hunted or captured habituate to the close presence of humans. It is clear that rapid habituation by cubs and sub-adult bears permits them to maintain access to an important, highly preferred food source (Gilbert, pers. observ.).

The predicted effects of capture on bears habituated to people are diagrammed in the second row of Figure 1. The actual effect on an individual bear will depend on the degree of habituation to people, the intensity and duration of pain, and other factors such as age and sex of the bear. In general the effect will be minimal. Some negative reactions to people may improve the probability of survival over the lifetime of the bear. Alternatively, if a habituated bear is attracted to a trap with food, creating a positive association with people, the beginning of "garbage-conditioning" may occur. Under conditions of seasonal food-stress, such a bear may be attracted to a campsite and be shot. I have labelled this outcome "aggressive food-seeking" where the bear is aggressive in the sense of not being deterred by yelling and other threats.

Instances of extreme habituation of brown bears to people are less common, probably because those individuals lacking fear of people are killed eventually because of their threatening or destructive behaviour.

In locations where bears have an ample food supply, and humans and their property are not threatened, the circumstances for the development of mutual tolerance are present. For example, on a number of salmon streams in Alaska, photographers and bears routinely pass within 60 m of one another. Even encounters at 10 m do not evoke charges from bears (Jope 1983, Braaten and Gilbert 1987). On the Alaska peninsula, the protected status of bears, abundant salmon, and consistent behaviour of visitors at the McNeil Falls State Sanctuary have resulted in brown bear adaptation to people unparalleled worldwide. As many as 103 bears have been seen in one day at the falls attempting to catch fish (L. Aumiller, pers. commun.). One female with spring cubs regularly approached the falls using the boardwalk to the gravel pad accommodating 10 people. Aumiller stated that she came to the gravel pad within 2 m of people, diverted around the immediate edge of the pad, and continued on to the falls. This illustrates the extent of habituation in brown bears that is possible if the behaviour of humans is benign and consistent. Under these highly regulated conditions, at least some bears are able to meet their nutritional needs without significant harassment or interference from people.

What is the effect of capture by darting on these bears? One would predict that bears at McNeil Falls, having learned to tolerate people as harmless, would have a rather mild response to such a capture process. Since they had not been previously sensitized to people at the Falls by negative conditioning, they would have no basis for associating the painful experience with people. Jim Faro, one of the biologists involved in the capture of bears at McNeil Falls from 1969 to 1972, told me that he explored the dart capture technique as an aversive conditioning procedure. He concluded that it did not work. When the bears recovered from the anaesthetic, they resumed their former behaviour at the falls. The darted bears "ignored people the next day". Caution in interpreting these observations is appropriate: the responses of the bears would likely vary with such factors as the type of drug, activities of the people prior to and after the firing of the dart, and exposure of bears to hunting when outside the sanctuary.

Faro and Eide (1974) stated that, prior to the imposition of restrictions, harassment by photographers disturbed bears and caused them to leave McNeil Falls. The Alaska Department of Fish and Game terminated research activities at McNeil River because of the "detrimental effects of extensive human activity". Disturbance of the bears was probably a consequence of capture activities and increasing visitor harassment. Capturing involved 2 teams stalking through the area, and darting with .22 blank rifle, handling, removing a tooth, tattooing, ear tagging and collaring bears. Sixty bears were tagged from 1962 through 1972 (L. Aumiller, pers. commun.). Surviving bears were immobilized a second time to remove collars (Faro 1971).

What were the effects of capture and handling on the subsequent response of the NcNeil Falls bears to photographers and other visitors? The tagging operation, which preceded the peak arrival of photographers and visitors, apparently aversively conditioned many bears to people over the 10-year period. Subsequently, the bears probably generalized to people with cameras. Groups of photographers blocked bears on trails and stalked bears to get pictures (J. Faro, pers. commun.). The mechanical sound of cameras would also resemble the noises of tagging personnel. Consequently some early McNeil bears were thoroughly sensitized. Other bears were physically displaced by people from trails, fishing spots, and resting areas (J. Faro, pers. commun.).

I have observed similar conditioning of habituated bears at Books Camp to the "click" sound of the safety release before "peppering" with a shotgun. Their avoidance reaction to the click was immediate and decisive. This explanation is not necessarily a contradiction of Faro's observation of minimal response to darting. At McNeil Falls, as at Brooks River, there was a core population of regular users of the river. Having become thoroughly habituated to human activities, they continued to frequent the areas near the river despite the delivery of an instant of pain. While they were more wary, their pattern of use was sufficiently established that they did not abandon the area. One bear was immobilized 6 times. A "few bears" that were more intolerant of people were never seen again at the falls after being darted (L. Aumiller, pers. commun.). Again our experience at Brooks Camp in 1985 and 1986 verified that some bears were not seen after 1 disturbing encounter. This information suggests that the disturbing effects of capture may be very minor under conditions where bears have habituated to people. In these cases all of the learning processes of adaptation to strange objects may be acting to promote acceptance and tolerance of people. These include not only habituation in adults, but possibly something like imprinting or socialization in cubs. It is well established that the acceptance of strange stimuli ("taming") is more easily evoked in young mammals. This process would be facilitated by the calm response of the cub's mother in transmitting the tradition of close approach to people to the cub. This type of "observational learning" is a powerful method of communicating the appropriate response in the offspring across a wide range of species (Galef 1976).

The Influence of Prior Positive Reinforcement From People on Capture Impacts

Bears which have fed near people approach people and developed areas more frequently. These food-conditioned bears have made associations (through positive reinforcement) between humans and food. Managers often refer to such bears as "garbage-conditioned", "food-rewarded", or "problem bears" because of their habitual food-seeking near campsites and developments.

A distinction between food-conditioning and habituation is important. Habituation to people refers to tolerance of proximity to people when the bear learns that no threat follows. A food reward is not necessary for this process. Thus the term "food-habituated" should be dropped because of the confusion between the 2 learning processes. Whether both processes are involved in the history of problem bears needs further investigation (McCullough 1982).

Hungry bears that have obtained garbage associated with human odour may strengthen those associations when attracted to capture sites by baits (row 3, Figure 1). While such food is positive reinforcement of the approach behaviour, the consequences for survival are eventually negative. As experience in many parks has shown, bears which feed on people's groceries or cause other damage eventually are removed from the population.

The influence of baiting will likely depend on the strength of the association that results from the food and human stimuli. It is not clear whether standard baiting establishes associations that cause bears to seek food more often at developed sites. However, the evidence favours this interpretation as bears have such good memories and the ability to learn from one experience ("single-trial learning").

When an animal continually returns to a trap for food, biologists label the animal "trap-happy". A grizzly bear that has little fear of people and a history of food-conditioning may approach campsites more aggressively when it is hungry (Herrero 1989). At a hunter's camp in the fall such bears risk being shot. However, this interpretation is simplistic by itself: if the trapping experience in total is negative and results in increased avoidance of developments, traps etc., then trapping may reduce mortality. The effects of a particular trapping effort must be judged on the basis of factors such as seasonal availability of natural foods, prior experience of the bears with people (i.e., level of potential food-conditioning), and the density of human occupation of the back-country, at least.

Evidence of Conditioned Aversion to People

One way to assess the behavioural effects of live-capture is to compare the cover-seeking and avoidance responses of bears frequently captured with bears in a non-handled population. Only populations with no history of hunting, shooting of problem bears, or poaching would qualify.

Before reviewing studies of bear responses to human encroachment, causes of avoidance other than live-capture need to be considered. Intense initial aversions would be established by: (1) hunting outside the park, (2) poaching, and (3) rough handling techniques that are painful or result in injury. These experiences would likely be generalized to all people so that increased human presence would subject the population to higher stress than otherwise.

For a control population (unhunted and unhandled) we have few good choices: populations in Glacier National Park, Alaska peninsula bears (although the rich summer food is a confounding variable), or reliance on the most trustworthy reports of trappers and explorers, e.g. Osborne Russell and Lewis and Clark. I think it is a reasonable assumption that these bears did not exhibit high sensitivity to human presence despite wide variation in behaviour. In other words strong avoidance responses to people were not present unless learned.

What is the evidence for avoidance of people by grizzly bears in the Yellowstone area? The evidence for a negative impact on bears was assembled by Yellowstone staff recently in justification of their policy of human use adjustments for important grizzly habitat in the park. Since that evidence has been presented elsewhere, and was sufficiently convincing to a Task Force panel of bear specialists (including myself) it will be summarized briefly. Note that only evidence, not the cause, of

				EXAMPLE	CAPTURE IMPACT
HIGH QUALITY HABITAT	AVOID	HIGH RECREATION USE	Not Food Conditioned	Kodiak Island	3
			Food Conditioned		
		LOW RECREATION USE	Not Food Conditioned		
			Food Conditioned		
	HABITUATED	HIGH RECREATION USE	Not Food Conditioned	Brook River McNeil Falls	1
			Food Conditioned		
		LOW RECREATION USE	Not Food Conditioned		
			Food Conditioned		
LOW QUALITY HABITAT	AVOID	HIGH RECREATION USE	Not Food Conditioned	Yellowstone N.P. Waterton N.P.	5
			Food Conditioned		
		LOW RECREATION USE	Not Food Conditioned		
			Food Conditioned		
	HABITUATED	HIGH RECREATION USE	Not Food Conditioned	Glacier N.P. Granite Park Bears	4
			Food Conditioned	Yellowstone Bear 15 Type	5
		LOW RECREATION USE	Not Food Conditioned		
			Food Conditioned		

1 = least impact

Figure 2. Ranking of capture effects on grizzly bears.

human-avoidance behaviour is being addressed. However, the hypothesis proposed is that live-capture procedures reinforce conditioned avoidance behaviour established earlier and culturally transmitted.

Evidence of human disturbance to Yellowstone bears comes primarily from 5 sources. Bear use in the Clear Creek area of Yellowstone Lake was inversely related to numbers of human intrusions from 1977 to 1984 (Jones et al. 1985). When spawning cutthroat trout and consequently anglers increased in numbers, grizzly use decreased. In the absence of people, bear numbers on the stream paralleled trout abundance.

A similar inverse relationship between numbers of bears and people has been documented for Pelican Creek. In early August 1978 the Pelican drainage was closed to visitors following a mauling. Grizzly bear use in that month reached its highest level. Other data on this creek presented by Gunther and Renkin (1985) lead to the same conclusion. Grizzly bears avoid the energy-rich open areas when people are present.

Knight (pers. commun.) monitored bear use of the upper Gallatin drainage in the Bighorn Pass/Fawn Creek area of northwestern Yellowstone Park. A closure in 1977 followed 2 maulings near Gallatin lake. Grizzly bear use of the area rose dramatically over the next 7 years, with 7 families (3 females with yearling offspring and 4 females with spring cubs) observed in the last year (1984) of the study. In 1984 there were approximately 50 marked and unmarked bears seen in the Gallatin, compared with 2 to 20 in the previous 10 years. This increase of over 2-fold occurred over 6 years, suggesting a long period to discover and develop traditional use of this new sanctuary area. It is important to note that this concentration occurred at a time when the best evidence indicated that total numbers of bears were stable or possibly declining slightly. Thus the greater use is attributable to a shift in areas used by the bears.

A similar shift to an area closed to visitors (but not trapping) occurred in the Mt. Washburn/Antelope Creek area between 1979 and 1984. The mean number of bears observed before the closure was 5, one-third the number recorded during the next 6 years after the closure.

The independent Task Force felt that the evidence presented by Yellowstone Park was convincing and justified the closure policy. The objective of the policy is to increase the use of important areas by grizzly bears that are sensitive to human presence. Whether this avoidance behaviour is a consequence of historically negative interactions with people is open to question.

Quality of Habitat

The influence of habitat quality on capture impacts can only be dealt with briefly here. The topic is important in determining which grizzly bear populations can tolerate live-capturing for research. Figure 2 incorporates 4 basic variables that can be used to rank bear populations on a scale of tolerant to vulnerable in relations to capture impacts.

To see how habitat quality affects impacts of live-capture, consider grizzly bears occupying seasonally diverse, richly productive habitats. Now assume a history of interactions with humans that results in maximum disturbance and displacement. Our earlier analysis predicts that live-capture will further intensify the aversive response to people. The consequences, then, of additional recreational or other forms of land use will be displacement of these bears from zones of high human activity.

Where habitat quality is high, displaced bears will move to nearby food sources perhaps within or near high-security cover. Conversely, populations in habitats of low quality, especially with limited choice of alternative foods, will be nutritionally stressed when displaced by disturbance from recreationists or research teams.

While this analysis is only broadly conceptual, it has the advantage of emphasizing the interactions between nutritional and behavioural (disturbance) variables. In this way is similar to the mortality submodel of the cumulative effects model developed by a subcommittee of the Interagency Grizzly Bear Committee (Weaver et al. 1986).

The scheme (Figure 2) provides one instrument to systematically assess criteria for regulating research captures. Beyond that is could serve to improve the productivity of populations by suggesting management manipulations to reduce stress. This follows because reduction in one variable, for example aversive conditioning, predicts an increase in a second variable: better access and use of limited, high quality habitat. The advantage of this strategy over "habitat" improvements to increase forage, for example, is more rapid implementation. Also, in national parks direct manipulation of the food base is not a current administrative option.

LITERATURE CITED

AUMILLER, L. 1984. Alaska's best bear show. Alaska Magazine (May) 18-21.

BATESON, P. P. G. 1982. Behavioral development and evolutionary processes. Pages 133-151 *in* King's College Sociobiology Group. Current Problems in Sociobiology. Cambridge Univ. Press.

BRAATEN, A. M., and B.K. GILBERT. 1987. Profile analysis of human-bear relationships in Katmai National Park and Preserve. Final Rep. to Natl. Park Serv., Alaska Region. 105 pp.

CLUTTON-BROCK, T. H., and P. H. HARVEY. 1978. Mammals, resources and reproductive strategies. Nature 273:191-195.

EGBERT, A. L. 1978. The social behavior of brown bears at McNeil River, Alaska. PH.D. Thesis, Utah State Univ., Logan. 172 pp.

EISENBERG, J. F., and D. E. WILSON. 1978. Relative brains size and feeding strategies in the Chiroptera. Evolution 32:740-571.

FARO, J. 1971. McNeil River bear study. Alaska Fish Tales and Game Trails. 27:10-11.

_____, and S. EIDE. 1974. Management of McNeil River state game sanctuary for non-consumptive use of Alaskan brown bears. Proc. Ann. Conf. Western Assoc. State Game and Fish Comm. 54:114-118.

GALEF, B.C. 1976. Social transmission of acquired behavior: a discussion of traditional and social learning in vertebrates. pages 77-100 *in* J. S. Rosenblatt, R. A. Hinde, E. Shaw and C. Beer, eds. Advances in the Study of Behavior, Vol. 6. Academic Press. New York, N.Y.

GEIST, V. 1978. Life strategies, human evolution, environmental design: toward a biological theory of health. Springer-Verlag, New York, NY. 495 pp.

GILBERT, B.K., and L. D. ROY. 1977. Prevention of black bear damage to beeyards using aversive conditioning. Pages 93-102 *in* R. L. Philllips and C. Jonkel, eds. Proc. of the 1975 predator symposium. Mont. For. and Conserv. Exp. Sta., Missoula, MT.

GITTLEMAN, J. L. 1986. Carnivore brain size, behavioral ecology and phylogeny. J. Mamm. 67:28-36.

GUNTHER, K. A., and R. RENKIN. 1985. The effects of backcountry recreational activity on bear use in the Pelican Valley area of Yellowstone National Park. Prelim. Progr. Report. Yellowstone Natl. Park. Mimeo. 36 pp.

HARDING, L. E., and J. A. NAGY. 1980. Responses of grizzly bears to hydrocarbon exploration on Richards Island, NWT. Int. Conf. Bear Res. and manage. 4:277-280.

HASTINGS, B.C., B.K. GILBERT, and D.L. TURNER. 1987. Black bear aggression in the backcountry of Yosemite National Park. Int. Conf. on Bear Res. and Manage. 6:145-149.

HERRERO, S. 1989. The role of learning in some fatal grizzly bear attacks on people. Pages - 9-14 *in* NWT Dept. of Renewable Resources, Bear-people conflicts proceedings: of a symposium on management strategies.

JAMIESON, I. G. 1986. The functional approach to behavior: is it useful? Amer. Nat. 127:195-208.

JONES, R. D., R. E. CRESWELL, K. A. GUNTHER, and L. D. LENTCH. 1985. Relationship between angler and bear use in the Clear Creek area of Yellowstone National Park. Pages 183-189 *in* Annual Project Rep. Yellowstone Nat. Park, 1984. U.S. Fish and Wild. Serv. Unpub. mimeo.

JOPE, K. 1983. Effects of motor vehicles on wildlife in Alaskan national parks: a literature review. Unpublished MS. 15 pp.

KRUUK, H., and D. MACDONALD. 1985. Group territories of carnivores: empires and enclaves. Pages 521-536 *in* R. M. Sibly and R. H. Smith, eds. Behavioral Ecology. Blackwell Sci. Publ. Oxford.

LOMNICKI, A. 1982. Individual heterogeneity and population regulation. Pages 153-167 *in* Kings College Sociobiology Group. Current Problems in Sociobiology. Cambridge Univ. Press.

MCCULLOUGH, D. R. 1982. Behavior, bears, and humans. Wildl. Soc. Bull. 10:27-33.

PEARSON, A. M. 1975. The northern interior grizzly bear (*Ursus arctos L.*). Can. Wildl. Serv. Rep. Ser. No. 34. 84 pp.

QUIMBY, R. 1974. Grizzly bear. Chapter II IN: Jakimchuk, ed. Mammal studies in northeastern Alaska with emphasis within the Canning River drainage. Arctic Gas Biol. Report Series, Vol. 24. Renewable Resources Consulting Services Ltd.

WEAVER, J., R. ESCANO, D. MATTSON, T. PUCHLERZ, and D. DESPAIN. 1986. A cumulative effects model for grizzly bear management in the Yellowstone ecosystem. Pages 234-236 IN: Proceedings - Grizzly bear habitat symposium, Missoula, Mont., April 30-May 2, 1985. Intermountain Research Stn., U.S. Dept. of Inter., Ogden, UT.

THE ROLE OF LEARNING IN SOME FATAL GRIZZLY BEAR ATTACKS ON PEOPLE

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Abstract: Between 1967 and 1986, there were 12 fatal attacks by grizzly bears (*Ursus arctos*) on people in Banff, Yellowstone, and Glacier (Montana) National Parks. The circumstances contributing to these deaths are analyzed, emphasizing the probable importance of changing human recreational behaviour, and of food-conditioning and habituation to people by bears. To minimize the number of deaths and injuries, we will have to manage food and garbage, the experience of grizzly bears with people, and people's activities, especially camping and grizzly bear photography.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Historical records suggest that grizzly bears were not important predators on people. Although this is still true, since 1967 fatal injuries inflicted by grizzly bears have increased in Glacier National Park, Montana, Yellowstone National Park, and Banff National Park (Herrero 1970, 1976, 1985). In this paper I ask why.

Beginning in 1967 a new type of incident occurred - grizzly bears for the first time killed people under peculiar, particularly horrifying circumstances, pulling the victims out of their sleeping bags in the nighttime. At the time of the first 2 deaths in 1967, several unsubstantiated theories were advanced as explanations: the weather was unusual, the bears had been fed hallucinogenic drugs, the young women who were killed attracted the bears because of the women's menstrual status (Herrero 1985).

We shall never be sure of the reasons for the 2 grizzly bear-inflicted fatalities in Glacier National Park, Montana in 1967. However, analysis of records of 12 fatalities in Glacier, Yellowstone, and Banff National Parks, 1967-1986, indicates some apparent patterns which I discuss in this paper.

I first analyzed what I thought were the likely contributing circumstances in my 1985 book *Bear Attacks: Their Causes and Avoidance*. Because of the controversial, but important (if true), findings, I have chosen to further analyze these cases (plus one new one) in this paper, emphasizing the importance of the bear's experience with people and the person's situation when the attack occurred. Because human actions have strongly influenced these fatalities, preventative management actions regarding people's food, garbage, and activities are needed and presented.

METHODS AND RESULTS

I examined case incident records and other information regarding 12 deaths inflicted by grizzly bears in Banff, Glacier (Montana), and Yellowstone National Parks, 1967-1986. Additional perspective was possible because I was a member of the board of inquiry that investigated the circumstances associated with 4 of the deaths. I interpreted information about the 12 grizzly bear-inflicted deaths from the perspective of changing relationships between grizzly bears and people, and in terms of learning.

Table 1 lists circumstances that might have influenced the fatal attacks. I tried to examine each of these possible circumstances for each incident. Often however, data were incomplete or possibly inaccurate. Despite the limitations of the data and the complex of variables that no doubt influenced each incident, I was able to identify some common circumstances.

Table 2 shows that for all 12 grizzly bear-inflicted deaths that occurred in the 3 national parks, the bear involved was either food-conditioned and/or habituated (Herrero 1985; Board of Inquiry Report regarding the death of William John Tesinsky, 1986). Table 2 also shows that 9 of the victims were partly consumed. Two of the incidents where the victim was consumed after death (Walker and Tesinsky) did not appear to have been motivated by predation (though this was possible). Rather, scavenging appears to have occurred after death. I regarded 7 of the 9 cases, plus one not involving consumption (Hegelson), as clearly involving predation. The 8 victims of probable grizzly bear predation were all attacked at night while camping and sleeping, and were pulled from or with their sleeping bags, and were killed. Seven of them were at least partly consumed.

Table 1. Possible circumstances that might have influenced fatal grizzly bear attacks in Yellowstone, Glacier, (Mont.), and Banff National Parks.

1. Random event
2. Research drugging and/or handling
3. Other drugging
4. Weather
5. Provocation
   a. Sudden encounter
   b. Dogs
   c. Photographers
   d. Teasing
6. Very aggressive personality of bear
7. Old age, infirmity, injury
8. Disease
   a. Rabies
   b. Trichinosis
9. Hunger or starvation
10. Food conditioning
11. Attractants
    a. Food
    b. Odours such as menstruation, perfume, deodorants
12. Opportunity of situation
    a. One or few people
    b. Remote
    c. No tent
13. Habituation
14. Interaction of several of the above

With regard to the 8 incidents that I classified as predatory, I assume that the bear's prior experience in all cases was predisposing. Six of these bears were food-conditioned, having learned to exploit people's food. All were habituated, showing, as a result of experience with people, willingness to tolerate people at closer distances - but obviously not total loss of "flight or fight" responses. Previous history of aggression toward people was recorded for only 2 of the bears (attacks on Koons and Mahoney). Clearly a history of aggression toward people was not a necessary predisposing factor.

In the 4 cases that I classified as not having been motivated by predation, the habituation of the bears involved either tempted photographers to approach closely during daytime (Etherington and Tesinsky), or brought a grizzly bear very close to major developments where people were common (Walker and Cohoe). It is worth noting that only 1 person (Cohoe) was hiking before being fatally attacked.

Examination of the age/sex class of bears involved in the fatal incidents revealed no clear pattern (Table 3). Food attractions (other than possibly the people themselves) were present in only 3 of the incidents (Koons, Walker, and Fredenhagen). There was no obvious condition of starvation or illness reported after autopsy of 10 or 11 bears, although these are hard factors to rule out as possible influences. All bears tested were negative for rabies. It is possible that some contributing factors were not recorded and were not understood.

DISCUSSION

Habituation and/or food-conditioning apparently predispose some grizzlies to kill people under certain circumstances. It is possible that the correlation is spurious and that a causal relationship does not exist. As I have previously pointed out (Herrero 1985), the causal relationship, if it exists, is a relatively weak one. It can be viewed as a predisposition awaiting specific circumstances, such as a hungry bear discovering a camper on the ground in a remote area, or a grizzly being approached by an aggressive photographer. This in no way denies the increased hazard of such bears, nor does it deny the multiple factors that interact to influence a bear to kill a person.

Additional perspective on the possible causes of the 12 deaths can be gained by discussing what is known of historical relationships between people and grizzly bears, and by examining learning in grizzly bears.

Grizzly Bears, and People Without Effective Firearms

Grizzly bears explore their environment in search of foods that yield high energy for the least "costs". I therefore assume that grizzly bears, which were in North America long before people, when first faced with people must have tested them as possible food. Grizzly bears being powerful, and carnivorous when opportunity exists, could easily kill a single, unarmed human being. While evidence is scanty regarding interaction between prehistoric North American Indians and grizzly bears, my interpretation is that grizzly bears seldom preyed on these Indians, at least during and around the time of contact with white people. Several historians have pointed to a sort of standoff between native people and grizzly bears (Storer and Tevis 1955, Ewers 1958).

Indians and grizzly bears occasionally foraged for the same foods, each being wary of the other. Sometimes an Indian was killed during a sudden encounter. More rarely I imagine, though I have not found records of this,

Table 2. Circumstances associated with fatal grizzly bear attacks in 3 national parks[a], 1967-1986.

Park	Person	Date	Grizzly Bear Food-Cond.	Grizzly Bear Habituated	Victim Fed On (Predation or scavenging)
Banff	Etherington	1973	Yes	Yes	No
	Cohoe	1980	Yes	Yes	No
Yellowstone	Walker	1972	Yes	Yes	Yes
	May	1983[a]	Yes	Yes	Yes
	Fredenhagen	1984	Probably not	Yes	Yes
	Tesinsky	1986	Somewhat	Yes	Yes
Glacier	Hegelson	1967	Yes	Yes	No
	Koons	1967	Yes	Yes	Yes
	Mahoney	1976	Yes	Yes	Yes
	Ammerman[b]	1980	Yes	Yes	Yes
	Eberlee[b]	1980	Yes	Yes	Yes
	Gordon	1980	Probably not	Yes	Yes

[a] One death occurred in the Gallatin National Forest, adjacent to Yellowstone National Park. A "park bear" was involved.

[b] Both persons were killed in the same incident.

Table 3. Age/sex class of grizzly bears involved in fatal attacks on people in 3 national parks.

Person	Age/Sex class of bear
Etherington	Adult male
Cohoe	Adult male
Walker	Adult female
May	Adult male
Fredenhagen	Unknown -- subadult male?
Tesinsky	Adult female
Hegelson	Adult female with cubs
Koons	Adult female
Mahoney	Subadult male
Ammerman[a]	Subadult male
Eberlee[a]	Subadult male
Gordon	Adult male

[a] Both persons were killed in the same incident by the same bear.

a grizzly might stalk, kill and consume an Indian. The converse was also true.

Grizzly bears probably did not include people in their normal "prey search image", even before modern firearms were developed and even though once dead a person would be high quality food. Why? One possible answer is that most bears who hunted people were themselves killed by groups of primitive human hunters. A bear might kill one person, but then die from wounds inflicted by others of a hunting band. Man, the highly social omnivorous predator, even before the advent of modern firearms, at least reached a balance of power with the larger and stronger, yet less social and less intelligent, grizzly bear.

However, although they apparently seldom preyed on people, grizzly bears may have been generally more aggressive toward people before the introduction of effective firearms. Some readers of Lewis and Clark's journals have drawn this conclusion because of the number of charges and attacks mentioned by them (Twaites 1959). This conclusion would be consistent with McArthur-Jope's (1982) and Nadeau's (1987) findings in Glacier Park, Montana. They showed that the *more* experience grizzly bears have with people, the *less* likely they are to confront or attack a person hiking.

Grizzlies encountered by Lewis and Clark's party would have been relatively inexperienced with people compared to grizzlies living today in Banff, Glacier (Montana) or Yellowstone National Parks.

Since the introduction of modern firearms, very aggressive grizzly bears, for example those that might charge from several hundred metres, have been eliminated. As soon as people had the power, "selection" began against bears that confronted or attacked people. Today most grizzly bears are tolerant of people (Herrero 1985).

Until recently in certain national parks, individual bears had little opportunity to learn to exploit people or their foods. Those that did usually died. Recently, however, with the creation of protected bear populations, the increase in camping and hiking as recreational pastimes, and the greater availability of people's food or garbage, the contingencies attached to some actions toward people and their foods have changed. By next discussing several dimensions of grizzly bear behaviour related to people and people's foods, I will suggest how human actions have probably created new opportunities for the expression of aggression by grizzly bears, as well as encouraged other undesirable bear behaviour.

Individual Distance, Avoidance and Habituation

I have suggested that historically, as a result of selection, most grizzly bears were wary of people. In order for foraging strategies to develop that bring grizzlies into close proximity with people, changes have had to occur in the bear's behaviour. One of the changes is habituation, a simple form of learning.

Each grizzly bear has an individual distance to which it will allow other bears or people to approach without overt response. The distance varies with season, location, individual bears, with regard to the identity of other bears encountered, and with regard to people under different situations. As a rule of thumb, both Herrero (1985) and Jope (In Press) have used about 50 m as the distance at which a grizzly bear is very likely to react to people with aggressive action or avoidance. When fishing congregations of Alaskan brown bears first begin to develop in a given season, the bears are wary of (stay farther away from) other bears (Egbert 1978). With repeated exposure to other bears the individual distance shortens. An analogous situation seems to develop with people. Most grizzly bears that are willing to forage with people nearby (and not all are) come to accept people at closer distances upon repeated exposure to them. Fleeing costs energy. Most grizzly bears respond to repeated exposure to a potentially harmful stimulus (people) by tolerating it at closer distances. This is clearly a learned response. It is called habituation. While habituated grizzly bears tolerate people at closer distances than do non-habituated individuals, they still have an individual distance which, if violated, may evoke aggression or avoidance. They may also be more likely to approach people who are camping.

Food Conditioning

"Operant conditioning" is another form of learning which occurs when a response emitted by an animal is either rewarded or punished. Psychologists, such as B. F. Skinner, believe that much of the behaviour of individuals of animal species that have a significant capacity to learn, such as bears do, is shaped by what follows an action. Operant behaviours, once well established, can be very resistant to "extinction". In other words, they may persist without reward or despite punishment, provided the reward is given occasionally.

I believe that grizzly bears become conditioned to people's food and garbage in the following manner. Grizzly bears are normally wary of people. This may be, as I have speculated, because wariness of people was a characteristic of successful, ancestral bears. But bears are also strongly motivated to find high-energy foods, and people's food and garbage are usually calorically concentrated. Therefore, when human-related foods are first sensed by a grizzly bear, an approach-avoidance conflict exists. A bear is attracted by the odour of food or garbage, and repelled by human presence or even the odour of people. Such food-seeking behaviour has thus far only been mildly rewarded by food odour (a secondary, not a primary reinforcer). At first the perceived risk may be too great for a bear to approach the food source. However, upon repeated exposure to similar situations, and if no harassment or harm occurs, then habituation develops. The bear comes to accept the smell of, or even the presence of, people nearby, and finally it feeds on the food or garbage. It is then food-conditioned.

Let me stress that this bear's behaviour has been molded by the outcomes associated with its actions. Once such conditioning has occurred it is difficult to extinguish, even if punished (such as by shooting the bear with rubber bullets or other aversive agents). Such a bear has been rewarded with energy-rich foods for little work. It has learned to accept the risks associated with eating human-related foods. It has also become habituated to some extent either to the smell or presence of people. It is less likely to flee from people, more likely to approach them.

Habituation, Food Conditioning and Grizzly Bear Attacks on People

In certain national parks before 1970, people's food and garbage were often available to grizzly bears. Previously, I showed that during this era, in 2/3 of all cases where injuries were inflicted by grizzly bears in the national parks, the bear had a history of food-conditioning and habituation (Herrero 1970, 1985). I assumed that an important change in behaviour occurred in such bears. Rather than being wary of people, they accepted them at closer distances under some circumstances but not under others. Since 1970, garbage and food management have improved dramatically; however, food-conditioned and habituated grizzly bears still exist, as do bears that are only habituated to people but apparently have not received food rewards. The rate of injuries correlated with these circumstances has declined (Herrero 1976, 1985), but fatal injuries associated with these circumstances have increased since 1967.

Aversive Conditioning

I have stressed that food-conditioning and habituation associated with fatalities in Yellowstone, Glacier (Montana), and Banff National Parks are learned responses. If grizzly bears learn these traits, then at least in theory, it should be possible for them to extinguish these responses and to learn to avoid people-related foods, or people themselves. Yet, to date, results of over 20 years of "spanking" bears with everything from rock salt to rubber bullets, have only been modestly encouraging. The most positive results have been on polar bears that have been deterred from seal scent baits by hard-hitting but non-injurious rubber bullets (Cushing 1983, Stenhouse 1984). Here, bears have learned avoidance of a specific site. The challenge, to achieve more generally useful results, is to get bears to generalize from site-specific avoidance to avoidance of, say, people-related foods wherever they occur, or to get them to generalize from avoiding rangers in uniform to avoiding all people. By using aversive conditioning under laboratory or field conditions (while the bear is held in captivity), it may be possible to expose a bear to a wide enough range of negatively reinforced situations to achieve the right degree of generalization - e.g., when released into the wild the bear may avoid what the researcher wants it to avoid. Preliminary results from ongoing experiments suggest some potential for this for both black (*Ursus americanus*) and grizzly bears (Jonkel, pers. commun.; Roop and Hunt, pers. commun.). However, even if generalized avoidance can be achieved, it should wane if the objects to be avoided are either attractants and/or appear regularly in the bear's environment. In other words, unnatural food sources would have to be removed if long-term avoidance of these is desired, or people's appearance would have to be regulated if habituation were not to occur again. The less experience a bear has with something, the easier it should be to teach avoidance behaviour.

SUMMARY AND CONCLUSIONS

Thousands of years of coexistence between grizzly bears and people probably resulted in the typical interaction being one of mutual avoidance. Certainly after the development of effective firearms successful bears avoided people. Historically, grizzly bears probably rarely if ever included people in their "prey search image," and grizzly bears that by their nature were very aggressive toward people were eliminated. Bears that learned to exploit people's food or garbage were usually killed.

However, since the establishment of the national parks, and particularly since the beginning of the outdoor recreation boom in the 1950's and 1960's, grizzly bears have had opportunities to learn to feed on food and garbage from recreationists. At the same time, grizzlies have encountered large numbers of hikers in areas where people did not used to go. This changed grizzly bear behaviour. Food-conditioning and/or habituation resulted in grizzly bears becoming less wary of people and more likely to approach them, or at least to not readily flee from them.

As long as recreation was largely confined to front-country areas, human fatalities resulting from grizzly bear-inflicted injuries were rare. Perhaps the bears were still somewhat wary when many people were grouped together in a front-country campsite, and perhaps park managers were more inclined to kill troublesome grizzly bears. But declining grizzly bear populations have led to a greater emphasis on maintaining numbers and protecting individual grizzly bears. At the same time the recreation boom has brought large numbers of visitors to front- and back-country areas, not all using designated campsites.

Correlated with this, 12 grizzly bear-inflicted deaths occurred in Glacier (Montana), Yellowstone and Banff National Parks during the period 1967 - 1986. The bears that caused the deaths were all known to be food-conditioned and/or habituated to people. These grizzly bears had lost some of their wariness of people, but so have hundreds if not thousands of other grizzly bears that have not injured, let alone killed, people. I propose that many such grizzly bears are predisposed to injuring people in certain circumstances (which seldom include sudden encounters with hikers, where they may be less dangerous), and that actual injury results when this predisposition interacts with other contributing circumstances. Some of the additional circumstances associated with fatal attacks between 1967 and 1986 were the presence of campers, often without tents (Herrero 1985) and hence in vulnerable situations, or habituated grizzly bears being approached by aggressive photographers. To better understand fatal attacks, we must also take into account other variables such as the bear's personality, degree of hunger, and perhaps even the bear's mood.

Aversive conditioning, such as shooting a bear with hard-hitting but non-injurious rubber bullets, has been demonstrated to be effective in teaching polar bears to avoid specific sites (Cushing 1983, Stenhouse 1984). Attempts to reeducate food-conditioned and/or habituated black bears and grizzly bears suggest that some, but limited success is to be anticipated (Jonkel, pers. commun.; Roop and Hunt, pers. commun.).

I recommend that efforts continue to focus on what grizzly bears have the opportunity to learn with regard to people and people-related foods. In areas where habituated or food-conditioned grizzly bears exist, human activities, especially camping and grizzly bear photography, should be carefully managed so that the risk of human injury is kept at acceptable levels.

LITERATURE CITED

BOARD OF INQUIRY REPORT: Regarding the Death of William John Tesinsky, 1986. Yellowstone National Park, Wyoming.

CUSHING, B. 1983. Responses of polar bears to human menstrual odors. Int. Conf. Bear Res. and Manage. 5:275-280.

EGBERT, A. L. 1978. The social behavior of brown bears at McNeil River, Alaska. Ph.D. Thesis, Utah State Univ., Logan. 117 pp.

EWERS, J. C. 1958. The Black Feet – raiders on the northwestern plains. Univ. of Oklahoma Press, Norman. 85 pp.

HERRERO, S. 1970. Human injury inflicted by grizzly bears. Science 170:593-598.

_____. 1976. Conflicts between man and grizzly bears in the national parks of North America. Int. Conf. Bear Res. and Manage. 3:121-145.

_____. 1985. Bear attacks: their causes and avoidance. Nick Lyons Books/Winchester Press. Piscataway, N.J. 287 pp.

JOPE, K. In Press. Use of interpretation to prevent bear incidents in Katmai National Park. Courier.

McARTHUR-JOPE, K. 1982. Interactions between grizzly bears and hikers in Glacier National Park, Montana. M.S. Thesis, Oregon State Univ., Corvallis. 100 pp.

NADEAU, S. M. 1987. Habitats, trails, and campground situations associated with grizzly-human confrontations in Glacier National Park, Montana. M.S. Thesis, Univ. Of Montana, Missoula. 76 pp + appendices.

STENHOUSE, G. 1984. Summary report: 1983 bear detection and deterrence program, Cape Churchill, Manitoba, NWT Dept. of Renewable Resources, Yellowknife. 6 pp.

STORER, T. I. and L. P. TEVIS, JR. 1955. California grizzly. Univ. of Calif. Press, Berkeley, CA. 335 pp.

TWAITES, R. G., editor. 1959. Original journals of the Lewis and Clark expedition, 1804-1806. Antiquarian Press Ltd., New York, N.Y. 7 vols. and atlas.

EFFECT OF BEARS EATING CAMPERS' FOOD ON HUMAN-BEAR INTERACTIONS

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Abstract: Interactions of back-country visitors and black bears (*Ursus americanus*) were studied in Yosemite National Park to determine if bear and visitor behaviour were affected by bears obtaining food from campers. Responses of bears and people were categorized into 1 of 4 classes: fear/escape, neutrality, approach, or aggression. After they had begun to eat backpackers' food, bears were more neutral toward people than would be expected by chance; they also approached visitors less often and demonstrated less fear of visitors. People were less aggressive, more neutral, and showed less fear of bears after the bear had their food; they usually watched the bear, talked to each other and photographed the bear. We concluded that visitors should try to discourage a nuisance bear before it obtains food, using proper food storage techniques and appropriate behaviour.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

National parks in the United States and Canada have a long history of management problems with bears. Management, to reduce encounters between bears and people, has stressed public education and removal of sources of unnatural food (G. F. Cole, unpubl. paper, Am. Assoc. Adv. Sci. Symp. on Res. in Natl. Parks, 1971). Benefits of these programs have been notable, but the number of incidents involving back bears continued to increase at an alarming rate during the 1970's in national parks, including Yosemite National Park in California.

In Yosemite Park, sharp increases in incidents involving damage occurred in the early and mid-1970's (D. R. Harms, unpubl. prog. rep., Yosemite Natl. Park, 1976). Due to improved management of bears in front-country areas, the incidence of damage began to decrease in 1976, However, a corresponding increase occurred in back-country areas (Harms 1980; W. B. Cella and J. A. Keay, unpubl. ann. rep., Natl. Park Ser., 1980.

Prior to this study, back-country bear management emphasized improved public information systems and installation of food suspension cables in several high-priority areas. However, these systems were not infallible. The National Park service became increasingly aware of the need to document interactions between bears and people in the back-country. For instance, park personnel had stated that bears appeared to be much more difficult to frighten away immediately after obtaining food from campers. Research was initiated to determine the factors affecting human-bear interactions. An important aspect of this research, reported in this paper, was the documentation of changes observed in the behaviour of humans and bears after a bear obtained food from campers.

This study was funded by the National Park Service (Contract # CX-1200-9-B051), Utah State University Mineral Lease Funds, and Utah State University Ecology Center. We are grateful to the National Parks Service personnel who helped in this effort, particularly J. Keay, J. van Wagtendonk, B. Cella, C. Hurst, J. Thompson, M. Meagher, and C. Martinka. Assisting in the field were R. Strong, J. Picton, M. Cherry, S. Hixson, M. Poyadue, and J. Pearson; their efforts are much appreciated. We also thank N. Hastings, S. Hastings, C. Ruibal, and M. Hamilton for their contributions.

STUDY AREA

The study was conducted in Yosemite National Park in east-central California on the western slope of the Sierra Nevada. Yosemite's vegetation types occur in broad belts, determined largely by temperature and precipitation (Hood and Hood 1969). Elevation varies from 648 to 3,997 m. In general, the climate is Mediterranean, with hot, dry summers and cool, moist winters. Little of the park is prime habitat for black bears, particulary at higher elevations (Graber and White 1983). However, bears have ranged in recent years into subalpine areas (Keay and van Wagtendonk 1983). Yosemite encompasses over 308,000 ha. About 277,000 ha are located in the back-country (Keay and van Wagtendonk 1983), which was defined by National Park Service officials as any portion of the park >1.61 km (1 mile) from a road. The remainder of the park is considered "front-country". There are 1,159 km of maintained trails. About 2/3 of back-country use by visitors occurs during the 100-day summer season between Memorial Day (late May) and Labor Day (early September), and about 40% of the visitation occurs in only 19% of the travel zones (van Wagtendonk 1981). Annual back-country visitation averaged over 70,000 visitations in the late 1970's (Keay and van Wagtendonk 1983).

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METHODS

We marked each of 22 bears with a lip tattoo and a vinyl streamer attached to a numbered cattle tag placed in the ear. Streamers were 5 x 7 cm and were pattern/colour-coded for quick field identification. We recorded interaction data for 17 marked bears and numerous unmarked bears. Some unmarked animals could be classified by sex and age (e.g., a mother with cubs).

Back-country visitors in the sample included people making both long trips and overnight visits. We also observed some day users interacting with bears.

We observed human-bear interactions in 9 areas, although 5 of these sites contributed over 99% of the data. Only 1 site was considered a day-use area, but numerous backpackers stopped there to rest and enjoy the scenery. All sites were characterized by relatively sparse vegetation, which allowed us to observe visitors and bears without interfering with interactions.

A human-bear interaction occurred when the presence of at least 1 person and/or 1 bear affected the behaviour of the other at that point in time. We observed interactions during June - September 1978 and May - October 1979 in campgrounds known for high levels of bear activity. Entire interactions were recorded, except for a few which were in progress when documentation began. In a party of several people, usually 1 person interacted most with the bear, and the data largely described the interaction of that person and the bear.

We divided interactions into 2 categories; "With Food Possession" and "Without Food Possession". "Food Possession" occurred when a bear began to eat campers' food, not when it contacted a food container. "Without Food Possession" included (1) all interactions where no unnatural feeding occurred and (2) behavioural sequences that occurred before the bear began feed on campers' food during an interaction. All other data were placed in the "With Food Possession" category.

Behavioural sequences were recorded primarily on cassette tapes. During analysis, the behavioural responses were divided into 4 major classes: fear/escape, neutrality, approach, and aggression. Fear/escape ("fear" in the text) usually consisted of bears walking away and running away from people, and visitors walking away from bears. Neutrality was manifested in behaviours that we considered inappropriate for other categories, such as bears watching people and visitors watching bears and talking to each other. Approach behaviour involved moving toward the other species in a nonaggressive manner. Aggression by bears most commonly involved running and jumping toward people; aggression by humans involved yelling and throwing objects at bears.

One of the authors (B. Hastings) and 2 assistants collected most data. Assistants were carefully trained, and their data collection procedures were examined, before their data were retained.

Statistical relationships were investigated using the chi-square test for goodness of fit. This procedure compares observed data to mathematically-generated expected values. No a priori assumptions about frequency probabilities were made. Our null hypothesis was that the frequencies of behaviour would occur proportional to the distribution of all behavioural categories in the 2 food-possession classes. For example, the expected value for the frequency of aggression in bears possessing food was the number of total aggression behaviours multiplied by the ratio (with possession: without possession) for total behaviours. The level of significance was established at $P < 0.05$. Degrees of freedom in all tests equalled 1.

RESULTS AND DISCUSSION

Visitor Responses

People were less aggressive than expected by chance after bears began to eat their food ($X^2 = 9.36$, $P = 0.003$) (Table 1). They also demonstrated less fear ($X^2 = 5.49$, $P = 0.021$) and more neutrality ($X^2 = 6.05$, $P =$

Table 1. Observed and expected frequencies of visitors' behaviour when bears did and did not obtain their food, Yosemite National Park, 1978-1979.

Behavioural category	Frequencies: Observed: Without possession	Frequencies: Observed: With possession	Frequencies: Expected: Without possession	Frequencies: Expected: With possession	Chi-square values: Without possession	Chi-square values: With possession
Fear/escape	361	64	339.31	85.69	1.39	5.49
Neutrality	3002	844	3070.52	775.48	1.53	6.05
Approach	520	126	515.74	130.26	0.04	0.14
Aggression	809	151	766.43	193.57	2.36	9.36

Table 2. Observed and expected frequencies of bears' behaviour when bear did and did not obtain campers' food, Yosemite National Park, 1978-1979.

Behavioural category	Frequencies: Observed: Without possession	Frequencies: Observed: With possession	Frequencies: Expected: Without possession	Frequencies: Expected: With possession	Chi-square values: Without possession	Chi-square values: With possession
Fear/escape	1459	210	1336.87	332.13	11.16	44.91
Neutrality	2553	843	2720.20	675.80	10.28	41.37
Approach	493	71	451.76	112.24	3.76	15.15
Aggression	60	10	56.07	13.93	0.28	1.11

0.015) than expected. The frequency of people approaching bears remained constant before and after bears obtained food ($X^2 = 0.14$, $P = 0.829$). The behaviour of back-country visitors after bears had obtained their food may have reflected a belief that efforts to recover food would have been ineffective or dangerous. The most frequent responses by visitors immediately after each instance of feeding were watching the bear, talking to others and/or pointing at the bear, and photographing the animal. In front-country areas, the opportunity to photograph and watch bears is probably a common reason for feeding bears. For backpackers in Yosemite, such opportunities were more of an accidental result of interactions; back-country visitors were never observed deliberately feeding bears. In fact, only 3 of more than 5,800 records were of visitors even attempting to feed bears. This behaviour is contrasted with the more common practice of deliberately feeding bears by visitors in front-country areas of the Great Smoky Mountains National Park (Tate and Pelton 1983). Back-country visitors were much more careful with their food than people in the front-country, perhaps due to the difficulty of replacing food and the absence of a convenient means (e.g., a car) to escape the consequences of feeding the bears.

Bear Responses

Bears were much more frequently neutral ($X^2 = 41.40$, $P < 0.001$), and showed much less fear ($X^2 = 44.89$, $P < 0.001$) after they had begun to eat. (Table 2). When feeding, they also approached people significantly less than expected by chance ($X^2 = 15.14$, $P < 0.001$). There was no change in their frequency of aggression. Bears often appeared to ignore people when feeding on campers' food. They neither moved toward nor away from people as often as would be expected by chance. This probably occurred because the bears' purpose in approaching visitors was to obtain food. Having obtained it, their attention was usually centered on the food and not on people. Bears often scattered food items over the ground while opening food containers, which may help explain why they did not walk farther from visitors.

These results demonstrate that bear behaviour is significantly altered after bears take campers' food. They also suggest that bears may indeed be more difficult to deter after they obtain food. Unfortunately, small sample sizes preclude testing the response of these bears to human aggression. We cannot determine adequately whether bears were less frightened because people were less aggressive, or whether visitors were less aggressive because bears were not as frightened. We suggest that bears would still have been less frightened after obtaining food if human aggression had remained constant. This is supported by the fact that, although the frequency of visitors approaching bears remained relatively constant before and after the bear obtained food, bears showed much less fear of people after they had the food. Hastings et al. (1981) found that, in general, bears responded to approach by people with fear (40.2% of responses) more than with any other category of response. However, bears in this study showed much less fear of people after possessing food, even though people approached them with the same frequency.

CONCLUSIONS

Behaviour of black bears in the back-country of Yosemite National Park was significantly altered by bears taking campers' food. They showed (1) less fear of people, (2) less tendency to approach people, and (3) more neutral behaviour after they had taken possession of campers' food. These results support to some extent the perception that bears may be more difficult to deter once they obtain food. The most significant management implication is that backpackers should prevent bears from gaining access to their food by storing it properly, and not expect to retrieve food from bears. Proper use of bear-proof cables or bear-proof portable food containers would reduce the need to threaten or chase bears from campsites. If back-country visitors need to discourage a nuisance bear, they should do so before the bear acquires their food. Retrieving food after the bear has possession of it will probably be more difficult. More importantly, reducing rewards for the bear prevents or helps to extinguish the nuisance behaviour that results in loss of food and damage to property.

LITERATURE CITED

GRABER, D. M., and M. WHITE. 1983. Black bear food habits in Yosemite National Park. Int. Conf. Bear Res. and Manage. 5:1-10.

HARMS, D. R. 1980. Black bear management in Yosemite National Park. Int. Conf. Bear Res. and Manage. 4:205-212.

HASTINGS, B.C., B. K. GILBERT, and D. L. TURNER. 1981. Black bear behavior and human-bear relationships in Yosemite National Park. Tech. Rep. No. 2, Coop. Nat. Park Resour. Studies Unit, Davis, Calif. 42 pp.

HOOD, M., and B. HOOD. 1969. Yosemite wildflowers. Flying Spur Press, Yosemite, Calif. 64 pp.

KEAY, J. A., and J. W. Van WAGTENDONK. 1983. Effects of Yosemite backcountry use levels on incidents with black bears. Int. Conf. Bear Res. and Manage. 5:307-311.

TATE, J., and M. R. PELTON. 1983. Human-bear interactions in Great Smoky Mountains National Park. Int. Conf. Bear Res. and Manage. 5:312-321.

Van WAGTENDONK, J. W. 1981. The effect of use limits on backcountry visitation trends in Yosemite National Park. Leisure Sci. 4:311-323.

MANAGEMENT AND BIOLOGY OF BROWN BEARS AT COLD BAY, ALASKA

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Abstract: The lower Alaska Peninsula supports high brown bear (*Ursus arctos*) and low human populations. Bears are fewer in number near Cold Bay than in adjacent remote areas. Research involving the capture and marking of 25 brown bears from the Cold Bay area began in 1976. Results indicate that local and transient bears avoid areas of human activity, and that local bears are more often drawn to garbage or other attractants. During the study, potential problem bears were transplanted. Maternal females, their attendant cubs, and weaned offspring most commonly used the area. These animals suffered higher mortality than did other population components. Since 1976, 23 ((82%) of 28 bears killed near Cold Bay were either mature females ($N=3$) or 2.5- to 3.5-year-old cubs. Overharvest of maternal females and cubs has depressed local recruitment.

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The town of Cold Bay, near the tip of the Alaska Peninsula, originated during World War II when the area was occupied by U.S. military forces. The present community has a mostly transient population of less than 200 people, primarily state and federal employees. Cold Bay is located on state-owned land surrounded by the Izembek National Wildlife Refuge (NWR), federally-owned land administered by the U.S. Fish and Wildlife Service (USFWS). The town is adjacent to excellent brown bear habitat and is less than 3 km from 2 anadromous fish streams.

Most brown bears avoid areas of human use near Cold Bay, but some bear-people encounters occur each year, typically involving subadult bears. Some bear-people encounters, such as those associated with bear hunting, viewing, or photography, are intentional. Unplanned encounters result from natural movements of bears or human negligence in eliminating attractants. The largely transitory nature of the human population necessitates an intensive public awareness program to reduce bear-people conflicts.

PAST MANAGEMENT

Hunting of brown bears near Cold Bay has been regulated since the 1940's. Bear population size, harvest pressure in adjacent areas, and public sentiment have been important factors affecting decisions by managing agencies. Table 1 describes hunting seasons and harvest trends from 1949 to the present.

Brown bear hunting seasons along the lower Alaska Peninsula, including the Cold Bay area, were open annually from the 1940's until 1969. The season extended from 1 September to 31 May. No permits were required for resident hunters, and no harvest quotas were established. From 1949 to 1969 an estimated 7.4 brown bears were harvested near Cold Bay each year. In 1969, a 496 km^2 (49,600 ha) area surrounding Cold Bay, including the road system (Figure 1), was closed to brown bear hunting by the State of Alaska Board of Game, presumably in response to a locally depressed brown bear population.

By 1974, the number of brown bears using the Cold Bay area had increased. Although more bears were seen, reported bear-people conflicts were rare. Between 1969 and 1974, 5 bears were shot in Defense of Life and Property (DLP) situations. One incident in 1974 resulted in a human casualty. This changed the attitude of local residents towards bears and resulted in a public petition requesting the reopening of the area to hunting. This was apparently one of the factors influencing the Board of Game's decision to reopen the Cold Bay area to hunting in May 1975. Stated justifications for this decision were the abundance of brown bears in the area, threats to the public and their property, and the request of local residents to allow hunting.

By 1975 the number of brown bears had increased in the Cold Bay area, and a limited harvest could probably have been supported along with various forms of non-consumptive use. Instead, liberal regulations were implemented allowing overharvest of the population. At least 16 bears were removed in 1975 alone (Table 1). A fall aerial survey by Izembek National Wildlife Refuge personnel in 1976 suggested that up to 40 brown bears used the central portion of the Izembek National Wildlife Refuge adjacent to Cold Bay. Annual harvest levels allowing maximum sustained yield for brown bears

Table 1. Brown bear harvest trends at Cold Bay, Alaska.

	Bear Hunting	No. of bears shot			(Avg/
Year	Season	Hunting	DLP	Total	yr)
1949-1969	Annual Spring/Fall	96[a]	Unk.	96[a]	(7.4)
1969-1974	Closed	0	5	5	(0.8)
1975	Annual Spring/Fall	16	0	16	(16.0)
1976-1979	Alt. Years Spring/Fall	33	2	35	(8.8)
1980-1984	Annual Spring/Fall (Limited permits)	12	1	13	(2.6)
1985-Present	Annual Spring/Fall[b]	0	1	1	

[a] Data located for 1949-1955, 1960, 1961, 1964-1967 only.

[b] Hunting allowed only if a "problem" bear is present.

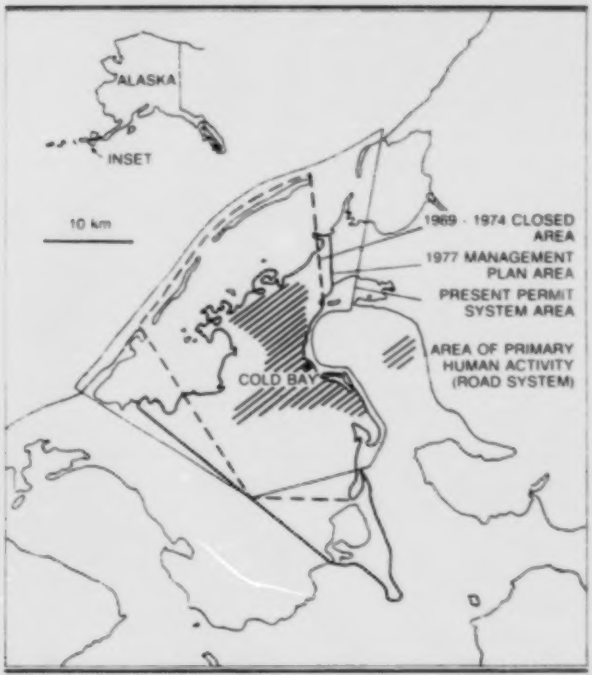
ALASKA
INSET
10 km
1969 - 1974 CLOSED AREA
1977 MANAGEMENT PLAN AREA
PRESENT PERMIT SYSTEM AREA
AREA OF PRIMARY HUMAN ACTIVITY (ROAD SYSTEM)
COLD BAY

Figure 1. Historical brown bear management areas at Cold Bay, Alaska.

have generally been estimated to be 5 - 6% (Cowan 1972). This would suggest that no more than 4 bears should have been harvested per year in the Cold Bay area. However, from 1976 through 1978, 29 bears were taken.

A draft 1977 Cold Bay Brown Bear Management Plan, prepared by the Alaska Department of Fish and Game (ADF&G) stated that the area supported a high density of brown bears with potentially a high proportion of older, large males resulting from the hunting closures between 1969 and 1974 (Alaska Department of Fish and Game 1977). The available survey and harvest data indicated that maternal females and small to medium size individual bears predominated in the area.

Beginning with the fall 1980 season, regulations were implemented to close the hunting season when 2 bears were taken. However, no animals were taken because of the depressed level of the bear population. Using this management approach, an annual average of 2.6 bears, mostly 2.5- to 3.5-year olds, were harvested from 1980 through 1984.

In 1981, the ADF&G prepared a number of wildlife management plans for consideration by the Alaska Board of Game, including a Cold Bay Brown Bear Management Plan (Alaska Department of Fish and Game 1981). The objectives of this plan were (1) to protect, maintain and enhance the brown bear population in concert with other components of the ecosystem, and thereby assure its capability of providing sustained opportunities to hunt brown bears under aesthetically pleasing conditions, and (2) to protect human life and property in human-bear interactions.

The Izembek National Wildlife Refuge stated its agreement to the concepts presented in this plan; however, no confirming action was taken by the Alaska Board of Game.

Beginning in the fall of 1984, the State Board of Game authorized a closed season for the Cold Bay area unless a "problem" bear was identified. Brown bears are presently uncommon in the area and only 1 DLP incident has occurred since 1981.

The various planning processes identified the need for basic biological data on bears in the Cold Bay area. Research designed to evaluate habits, movements, and activity patterns of bears in relation to human activities at Cold Bay and on the adjacent Izembek National Wildlife Refuge began in 1977 (U.S. Fish and Wildlife Service 1977).

Table 2. Capture information and status of marked brown bears, Cold Bay, Alaska.

						Current Status			
Age/ Sex	N	$\bar{X}$ Age	Male	Non-Maternal Female	Maternal Female	Shot by Hunter	DLP	Natural Death	Unk.
Adult Male	2	11.5	2			1			1
Adult Female	8	6.6		4	4	2	1	1	4
All Cubs	15	2.3	6	9		6	2	1	6

Table 3. Ages and annual rates of capture and relocation of brown bears at Cold Bay, Alaska.

	Number of Bears		Age		Relocations of Marked Animals	
Year	Captured	Collared	$\bar{X}$	Range	Total	Range
1976	2	0	2.5		9	4-5
1977	7	4	3.8±2.2	(7.5-1.5)	179	1-47
1978	4	1	3.9±2.4	(8-2.5)	70	1-33
1979	0	0			4	1-3
1980	0	0			0	
1981	9	2	3.8±2.9	(9.5-1.5)	171	2-25
1982	0	0			75	1-43
1983	1	0	15		37	1-26
1984	1	1	4.5		18	18
1985	1	1	4.5		2	2
Totals	25	9	4.2±3.4		565	1-47

METHODS

From 1976 to 1985, brown bears were captured within a 15-km radius of Cold Bay using immobilizing drugs. Bears were captured opportunistically without selecting for sex or size. During the course of the study 9 animals were fitted with radio collars (Telonics, Mesa, AZ). All animals were tattooed for permanent identification and fitted with numbered ear tags with coloured flagging. A premolar was removed from each bear of unknown age to make an age determination. Attempts to relocate marked animals were opportunistic, normally at bi-weekly intervals. Minimum home range of individual bears was defined as the area encompassing all radio relocations. A primary use area, where 70 to 80% of relocations were made, was determined for each radio-collared bear.

To estimate population size and trends, fall aerial stream surveys were flown between 1976 and 1982 in a Cessna 185 (1976) or Piper Super Cub (1977-1982). Two observers flew at 50 m above ground level during crepuscular periods. They estimated size of single bears and recorded the number of cubs in family groups.

RESULTS AND DISCUSSION

Population Sex and Age Structure

Between 1976 and 1985, 25 brown bears were captured (Table 2). Of the 9 animals radio-collared, 4 were sows with cubs. Eight of the 10 cubs in these family groups were captured and marked. Average age of the 25 bears captured was 4.2±3.4 (1SD) years (Table 3).

Subadult bears predominate in the Cold Bay population which suggests that adult bears avoid areas of human activity. Data also suggest that females comprise the majority of adult brown bears in the Cold Bay area. Subadult brown bears may show fidelity to their natal areas. Reynolds and Hechtel (1986) suggest that young

Table 4. Trends in brown bear densities determined by aerial surveys near Cold Bay, Alaska.

	Number of bears seen in relation to town	
Year	10km radius (km^2/bear)	10km-35km radius (km^2/bear)
1976	8(25)	97(18)
1977	11(18)	104(16)
1978	14(14)	64(27)
1979	1(200)	107(16)
1980	15(13)	94(18)
1981	17(12)	116(15)
1982	5(40)	147(12)
avg.±1SD	10.1±5.8(20)	104.1±2.50(17)

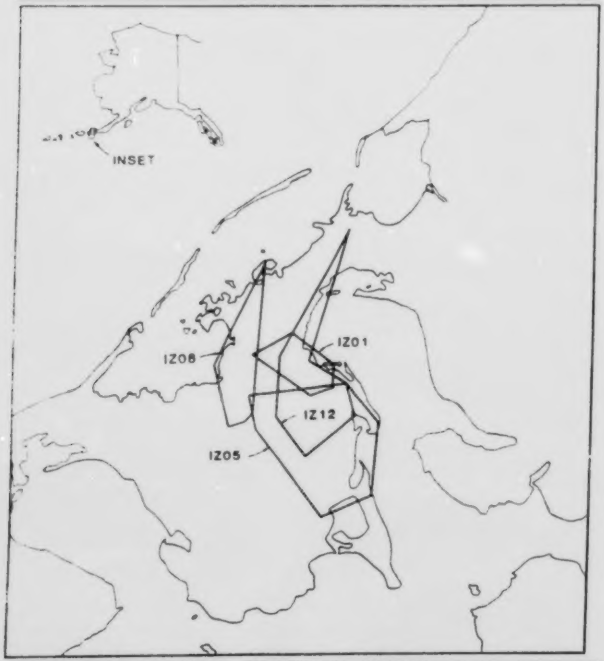

Figure 2. Minimum home range polygons of female brown bears with cubs near Cold Bay, Alaska.

female grizzly bears remain close to their maternal home ranges while less than half the males remain. Due to poor survival of marked cubs near Cold Bay, the hypothesis that weaned cubs would remain in the area could not be evaluated.

The average age of adult females captured near Cold Bay is less than that of females in adjacent remote areas. This suggests that adult females may prefer, or at least survive better in, remote areas that have higher densities but lower harvest rates. In remote areas with higher densities, within 25 km of Cold Bay, the average age of 21 adult female brown bears was 13.7±5.7 (1SD) years (U.S. Fish and Wildlife Service 1984, 1985). The average age of 8 adult females captured during this study was 6.6±1.8 (1SD) years. The greater probability of local bears dying as a result of their proximity to people may bias this comparison. Three of the 8 local adult females captured were shot, 2 by hunters and 1 in a DLP incident. Hunting pressure in the Cold Bay area is probably directed toward adult females as fewer large male bears are present.

Numbers and Densities of Bears

Numbers and densities of brown bears observed at different distances from Cold Bay are shown in Table 4. Estimated population sizes are based on fall aerial surveys conducted from 1976 to 1982. The aerial surveys began as the local bear population entered a depressed state. Brown bear densities averaged 1 bear/20 km^2 from 1976 to 1982 in the Cold Bay road system. Higher densities of 1 bear/17 km^2 were estimated for adjacent remote areas. In 1982, the 200-km^2 Cold Bay road system supported an estimated 1 bear/40 km^2 compared to 1 bear/12 km^2 in adjacent areas. Subjectively, it appears that numbers of bears near Cold Bay have not changed since 1982.

Data suggest a gradually increasing bear population in adjacent remote areas and a low, but relatively stable, number closer to Cold Bay. Although numbers of bears observed near the areas of human activity tend to indicate stability, it appears that the numbers of bears resident in the local area have declined compared to transients, as evidenced by high mortality of marked bears. This suggests that harvest may have limited local recruitment.

Home Ranges and Activity Patterns of Bears in Relation to Areas of Human Activity

Home range sizes were determined primarily by aerial tracking of radio-collared bears. Females with cubs exhibited varied responses to areas of human activity. Of the 4 females with cubs captured during the study, only one (IZ01) included Cold Bay and the dump in the primary use area within her home range. Another sow (IZ12) included Cold Bay in her home range, but area of primary use indicated avoidance of people. Home ranges of 2 other maternal females suggested complete avoidance of areas of human activity. Home range size

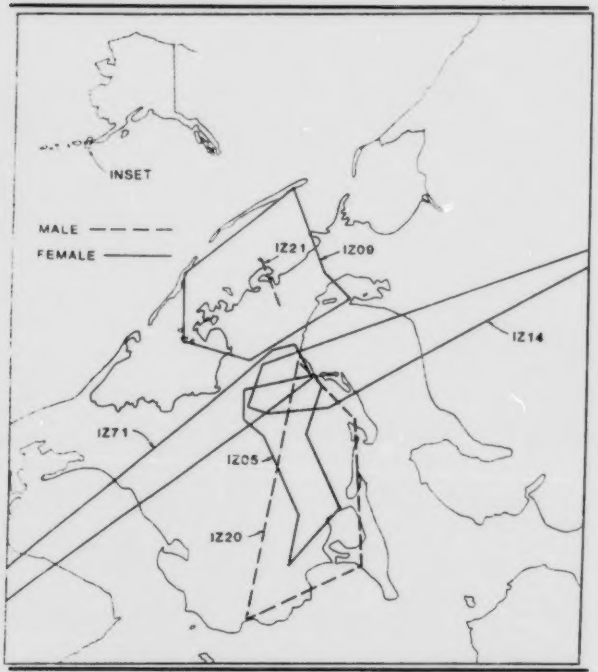

Figure 3. Minimum home range polygons of adult male and single female brown bears captured near Cold Bay, Alaska.

for females with cubs averaged 81.1 km^2 (range 32.5 to 149.9 km^2) while primary use areas averaged 22.8% (range 9.1% to 37.5%) of their observed home range (Figure 2). Four non-maternal adult females also reacted to people and areas of human habitation in variable ways. Two used the dump on a regular basis; however, primary use areas suggested general avoidance of town by both bears. Home ranges for non-maternal adult females averaged 252.9 km^2 (range 109.3 to 501.7 km^2). Primary use areas averaged 21.6% (range 0.8% to 37.0%) of their observed home range (Figure 3).

Subadult bears, often the weaned cubs of females that frequented the local area, were most tolerant of people and areas of human activity. Young bears also seemed to be involved in bear-people interactions more commonly than older bears. During the course of the study, 10 marked bears made regular visits to the dump. Six of these were 2.5-(N=2), 3.5-(N=2) and 4.5-(N=2) year-old subadults; 1 was a 6.5-year-old sow; and 1 was a 6.5-year-old sow with 2 yearling cubs. This latter animal was shot in a DLP incident after which her cubs continued to use the dump. Average age of the 10 bears habituated to the dump was 3.4±1.8 (1SD) years. Three of these bears were shot in DLP incidents. However, only one of them, a 2.5-year-old male, may have been a "problem" bear in that random destructive activities typified some of its behaviour. All other incidents related to DLP shootings could be traced to human negligence, normally improper disposal of some attractant. Two young bears which were captured and radio-collared at the Cold Bay dump were later shot and not reported. Two other local bears were shot by hunters and 1 died of natural causes at or near the den site. The status of the remaining bears captured locally is undetermined. Home range size for four 3.5-year-old and four 2.5-year-old bears averaged 146.8 km^2 (range 8.1 to 501.7 km^2), and 242.9 km^2 (range 4.1 to 647.6 km^2) respectively (Figures 4 and 5).

High variability in home range size of 2.5- and 3.5-year-old bears resulted from the number of observations of individual animals.

Two adult males, aged 7.5 and 15.5 years, were captured in the Cold Bay area during the study. During 6 years of fall surveys in the area only 1 bear was classified as large, probably an adult male. Adult males are uncommon in the area and probably actively avoid areas of human activity. Only the 7.5-year-old male used the dump and was also seen in town while moving through the area. The older male was not seen again after capture. The home range of the 7.5-year-old male was 218.6 km^2 (Figure 3).

Relocation of Bears

Three 2.5-year-old females captured at the Cold Bay dump were transplanted by aircraft to remote areas and released. One was moved approximately 200 km northeast and the other 2 were moved 100 km southwest. All 3 bears moved 20 - 60 km from release sites to areas of human habitation within a few days. At least 1 was shot in a DLP incident. These observations agree with those of others (Cole 1971, Craighead and Craighead 1971, Miller and Ballard 1982) suggesting that transplanting of problem bears is ineffective. It either transfers the problem to other areas of human habitation or the bears return to their original locations.

Movement patterns exhibited by 2 other young bears (1 male, 1 female) captured at the Cold Bay dump suggest that bears which have habituated to an area of human activity show tendencies to move to other areas of human activity even if they are not transplanted. Both bears were shot near the village of False Pass, 60 km southwest of Cold Bay. The circumstances resulting in the bears' deaths are unknown. The male was tracked as a 2.5- to 3.5-year-old and the female was tracked as a 4.5- to 6.5-year-old and neither was reported to be a problem bear. There were 79 radio locations made of

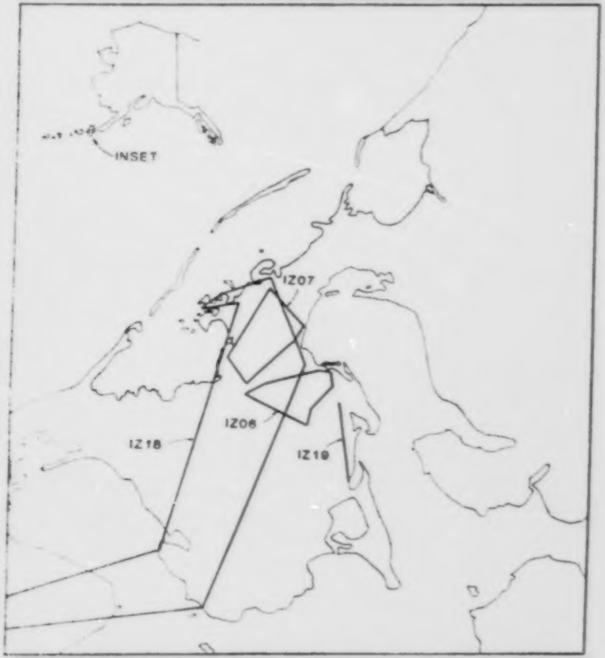

Figure 4. Minimum home range polygons for solitary 3½-year-old brown bears near Cold Bay, Alaska.

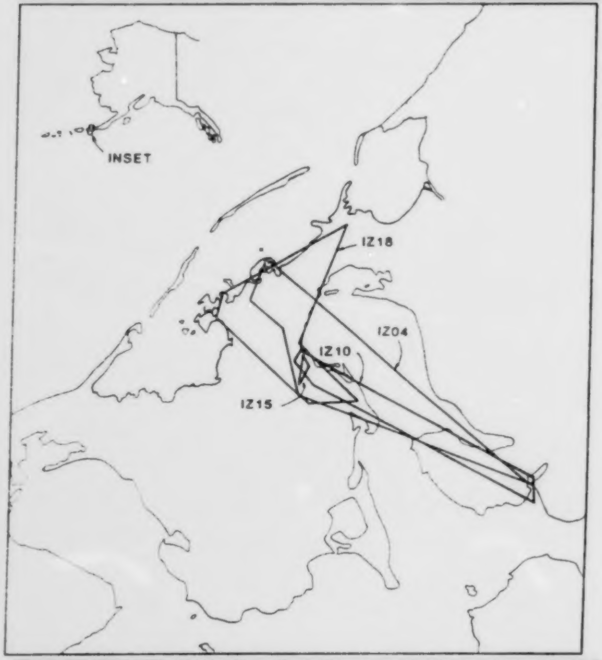

Figure 5. Minimum home range polygons for solitary 2½-year-old-brown bears near Cold Bay, Alaska.

these 2 bears, and essentially all were near areas of human activity.

Bear-People Conflicts

From 1970 to 1988, 9 brown bears have been shot in DLP situations in the Cold Bay area. Seven of the 9 DLP incidents involved cubs recently displaced from family units. The 2 other DLP incidents involved interactions with an adult male and an adult female with 2 yearling cubs. In each DLP situation, bears were attracted to a source of food. The conflicts probably could have been avoided had people used common sense and disposed of the attractant properly.

During the same period, 1 human fatality and 1 mauling occurred in the Cold Bay area, both in early August during peak salmon runs. The fatality of a photographer probably resulted from his camping beside a salmon stream during a peak spawning period.

The mauling involved a person camping on a barrier island of Izembek Lagoon. It occurred because the individual approached a food and water source defended by the bear. Analysis of the site after the mauling showed fresh bear trails and beds around a freshwater source and a partially devoured sea lion carcass within 50 m.

Bear-people encounters in the Cold Bay area that have not resulted in human injury or a bear's death have been difficult to quantify. Fishing, hunting, trapping and berry picking are all popular activities that bring people into brown bear habitat. Sightings of brown bears are occasionally reported, but represent an unknown proportion of all encounters. Conflicts or near-conflicts are probably reported more consistently than routine sightings. Such incidents are rare, suggesting brown bears commonly avoid people and areas of human activity in the absence of attractants.

Mortality Patterns

Life spans and mortality rates of bears in the Cold Bay population can be compared to those of an adjacent area of the Alaska Peninsula (Moffet Bay) with a higher bear density and much lower harvest pressure (U.S. Fish and Wildlife Service 1985) (Tables 5 and 6). Average life span of marked adults was 4.5 years greater in the Moffet Bay area than near Cold Bay. However, the

Table 5. Life spans and mortality rates of brown bears captured at Cold Bay and Moffet Bay, Alaska Peninsula.

Area	Subjective Harvest Level	Average Life Span (years) Adults (N)	Average Life Span (years) Cubs (N)	% Mortality of marked bears Adults (N)	% Mortality of marked bears Cubs[a] (N)
Cold Bay (1976-1983)	moderate high	8.2±2.0 (4)	3.3±1.0 (10)	57 (7)	63 (16)
Moffet Bay (1984-1986)	low	12.7±9.4 (7)	1.4±0.6 (18)	20 (35)	43[b] (42)

[a] Cubs 0.5-2.5 years old.

[b] From data up to 3 years after capture.

Table 6. Life spans of bears marked in the Cold Bay road system (1976-1983).

Age/ Sex	N	$\bar{X}$ Age at Capture	No. Dying During Study	$\bar{X}$ Lifespan (years)±1SD[a] Post-Capture	$\bar{X}$ Lifespan (years)±1SD[a] Overall
Adult Male	2	11.5 yrs. (4.0)	1	0.3	7.8
Adult Female	8	6.6 yrs. (1.8)	4	0.9±0.8	8.3±2.3
3.5 yr. olds	2		2	0.3±0.1	3.8±0.1
2.5 yr. olds	7		3	1.0±1.4	3.8±2.1
1.5 yr. olds	6		4	1.5±0.5	3.0±0.5

[a] Life span for bears dying during the 7-year study.

average life span of cubs (0.5 to 2.5 years old) was 3.3 years in the Cold Bay area compared to 1.4 years in the Moffet Bay area. Adult male brown bears are thought to be an important cause of cub mortality (Troyer and Hensel 1962; Mundy and Flook 1973; Egbert and Stokes 1976; Pearson 1975; Reynolds 1976, 1980; Reynolds and Hechtel 1982, 1983, 1986; Miller 1984). Accordingly, increased survival rates would be expected for cubs in the Cold Bay area, as data indicate that adult males occur in low numbers and generally avoid the area. However, the influence of low numbers of adult males is apparently negated by a high rate of human-caused mortality.

Twenty (71%) of the bears shot near Cold Bay since 1976 were cubs 2.5- to 3.5-years old. Of 16 cubs marked in the study, 10 (63%) died. Nine cubs of these were shot at less than 4 years of age. Mortality of marked cubs in the Moffet Bay area is lower (43%, *N*=42) even though there are more adult males in the population (U.S. Fish and Wildlife Service 1985). With this level of mortality near Cold Bay it is improbable that the 3 to 5 maternal females believed to be resident in the area could produce and rear sufficient offspring to maintain the population of local bears. Rebuilding of a population from a depressed state may be a slow process unless harvest pressure on local animals, and bear-people conflicts, can be reduced.

CONCLUSION

In the past 20 years variable approaches to brown bear management with respect to seasons and harvest levels have been implemented in the Cold Bay area, often without supportive biological data. Density of brown bears in the Cold Bay area has varied considerably throughout this period, largely in response to harvest pressure.

This study suggests that brown bear densities near Cold Bay are lower than in adjacent areas of the Alaska Peninsula. Most bears observed in the Cold Bay area are adult females and their cubs. Resightings of marked individuals within these components of the population suggest fidelity for small geographic home ranges prior to weaning. Analysis of movements in home ranges of maternal females in nearby areas of the Alaska Peninsula substantiate this assumption (U.S. Fish and Wildlife Service 1985, 1986).

Subadult bears predominate in the Cold Bay area, while the majority of the adults observed are females. Adult males are uncommon in the area. Most bears avoided areas of human activity, however some, primarily subadults, became habituated to the dump. "Dump" bears were the most likely to become problem animals and involved in DLP situations.

Because movements and behaviour of brown bears at Cold Bay were poorly understood, management practices allowed harvest levels to increase above a level sustainable by the local population. Local adult females and their offspring have made up a majority of the brown bear harvest, which has essentially eliminated local recruitment.

The Cold Bay population of brown bears is currently low as a result of mortality which exceeded production throughout the study period. Evidence supporting this is the age ratio of the harvest, which consisted primarily of 2.5- and 3.5-year-old bears. It seems apparent that harvest should be maintained at a low level if we are to ensure adequate recruitment of local bears. Brown bears are long-lived, but their productivity rates are low. These characteristics, in combination with poor cub survival, suggest that recruitment of breeding age animals from the Cold Bay area occurs at a very low rate.

Bear-people conflicts have been minimized due to low numbers of bears in the area and an increased public awareness campaign by the USFWS. No "problem" bears have been identified. It is hoped that the local brown bear population will respond to current protection and the increased level of public awareness, which will in turn allow managing agencies to prepare a cooperative long-range plan.

MANAGEMENT DIRECTION

One goal in the management of a brown bear population is maintaining optimum numbers within the carrying capacity of the habitat, while allowing various forms of use. At Cold Bay, management must also allow for the recovery of a depressed population. In some situations, agency goals may be to maintain a population below optimum numbers or at a somewhat depressed level. Brown bear management at Cold Bay has tended to follow this latter direction to encourage a sense of public safety. Hunting has been the management tool used to approach this goal. In reality, the tendency of most bears to avoid people and areas of human activity may naturally limit local population size (Lebedeva and Sinitsyn 1986). Whether bear numbers are high or low, the most efficient way to increase the public's safety while in bear country is to increase awareness of safety precautions and the use of common sense.

The ADF&G has the primary responsibility for management of resident game, including brown bears. The USFWS has the complementary responsibilities of conserving wildlife populations and their habitats on national wildlife refuges. The approach of the USFWS in management planning efforts would be to cooperate with ADF&G in establishing appropriate goals to meet both agencies' responsibilities for maintaining bear populations and habitat as well as public use. Such efforts should address consumptive and non-consumptive uses of brown bears. A cooperative, responsive approach to brown bear management at Cold Bay will ensure continued public use opportunities while minimizing bear-people conflicts.

LITERATURE CITED

ALASKA DEPARTMENT OF FISH AND GAME. 1977. Alaska wildlife management plans, southwestern Alaska. Alaska Dept. Fish and Game Fed. Aid in Wildl. Rest. Proj. W-17-R. 238 pp.

_____. 1981. Cold Bay brown bear management plan. Alaska Dept. Fish and Game, Juneau. 5 pp. (mimeo).

COLE, G. F. 1971. Preservation and management of grizzly bears in Yellowstone National Park. Bio Science 21(16):858-864.

COWAN, I. McT. 1972. The status and conservation of bears (*Ursidae*) of the world - 1970. Int. Conf. Bear Res. and Manage. 2:343-367.

CRAIGHEAD, J. J., AND F. C. CRAIGHEAD, JR. 1971 Grizzly bear-man relationships in Yellowstone National Park. BioScience 21(16):845-857.

EGBERT, A. L., and A. W. STOKES. 1976. The social behavior of brown bears on an Alaskan salmon stream. Int. Conf. Bear Res. and Manage. 3:41-56.

LEBEDEVA, N. L., and M. G. SINITSYN. 1986. The behavior of brown bears (*Ursus arctos*) in the Kronotsky State Reserve during encounters with men. Zool. Zhur. 64(12):1903-1905.

MILLER, S. 1984. Big game studies. Vol VI. Black bear and brown bear. Susitna Hydroelectric project, 1983 annual report. Alaska Dept. Fish and Game, Anchorage. 174 pp.

_____, and W. B. BALLARD. 1982. Homing of transplanted Alaskan brown bears. J. Wildl. Manage. 46(4):869-876.

MUNDY, K. R. D., and D.. R. FLOOK. 1973. Background for managing grizzly bears in the National Parks of Canada. Can. Wildl. Serv. Rep. Ser. 22. 35 pp.

PEARSON, A. M. 1975. The northern interior grizzly bear *Ursus arctos* L. Can. Wildl. Serv. Rep. Ser. 34. 86 pp.

REYNOLDS, H. 1976. North Slope grizzly bear studies. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Final Rep. Proj. W-17-6 and 7. Jobs 4.8R - 4.11R, Juneau. 20 pp.

_____. 1980. North Slope grizzly bear studies. Alaska Dept. Fish and Game. Fed. Aid in Wild. Rest. Proj. Rep. Proj. W-17-11. Jobs 4.14 - 4.15R, Juneau. 75 pp.

_____, and J.L. HECHTEL. 1982. North Slope grizzly bear studies. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Proj. Rep. Proj. W-21-2. Job 4.14R, Juneau 19pp.

_____, and _____. 1983. North Slope grizzly bear studies. Alaska Dept. Fish and Game. Fed. Aid in Wild. Rest. Proj. Rep. Proj. W-21-2. Job 4.14R, Juneau. 22 pp.

_____, and _____. 1986. Population structure, reproductive biology and movement patterns of grizzly bears in the northcentral range. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Final Rep. Proj. W-21-2, W-22-2, W-22-3 and W-22-4. Job 4.16R. 53 pp.

TROYER, W. A., and R. J. HENSEL. 1962. Cannibalism in brown bear. Anim. Beh. 10(3-4):231.

U.S. FISH AND WILDLIFE SERVICE. 1977. Brown bear study, annual report, 1977 field season. Izembek Natl. Wildl. Refuge, Cold Bay, Alaska. 19 pp.

_____. 1984. Izembek Natl. Wildl. Refuge annual narrative report, Cold Bay, Alaska. 146 pp.

_____. 1985. Izembek Natl. Wildl. Refuge annual narrative report, Cold Bay, Alaska. 158 pp.

MOVEMENTS OF GRIZZLY BEARS NEAR A CAMPGROUND IN GLACIER NATIONAL PARK

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Abstract: Grizzly bear (*Ursus arctos*) movements near a campground and back-country chalet in Glacier National Park, Montana were monitored from 1982 through 1984. Observations of bears were mapped, and nocturnal movements were monitored primarily by using track grids. Grizzlies used trails and investigated areas near the campground more frequently at night and during September than at other times. Bears consistently avoided the campground when campsites were occupied, but frequently travelled through the campground when campers were absent. Females with young investigated the campground area more frequently at night than during the day, suggesting temporal resource partitioning in response to predictable visitor use. Grizzlies foraged primarily on glacier lilies (*Erythronium grandiflorum*), and spring beauties (*Claytonia lanceolata*) in the spring, horsetail (*Equisetum* spp.) and grasses (*Graminae* spp.) during the summer, and huckleberries (*Vaccinium* spp.) during the fall.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Six human deaths were inflicted by grizzly bears in Glacier National Park from 1967 through 1985. All occurred in situations when hikers were camped. One such situation occurred at Granite Park Campground in 1967. Bears using the Granite Park area were frequently fed garbage, and a female conditioned to garbage was blamed for the camper's death and destroyed. After the incident, the garbage was removed, the campground was relocated, and ranger visits to the campsite were increased. In 1976, a camper was killed by a grizzly at another campground less than 12 km from Granite Park. That prompted another review of bear management policies in Glacier. In 1977, intensive bear and people management actions were initiated at Granite Park to reduce the possibility of dangerous human-bear encounters. A Bear Management Ranger was stationed at Granite every night from 4 July through the end of August, and since 1982, through the end of September. The Ranger's major duties were to assure clean camping techniques by campers and to monitor bear movements in the area. From 1977 through 1985, no human-bear conflicts at Granite Park resulted in human injury. However, 2 hikers were injured by a grizzly bear less than 1 km from the campground in September 1986.

A proposal was considered in 1981 to build a "bear-proof" shelter for hikers at Granite Park. Due to the lack of scientific evidence detailing grizzly bear use of the Granite Park area at night, a research project was initiated in 1982 to gather information on nocturnal use patterns of grizzly bears.

This paper reviews both the nocturnal and diurnal movements of grizzly bears in the Granite Park Area in relation to a campground and back-country chalet from 1982 through 1984. Temporal and spatial distributions of grizzly bears and seasonal differences in relation to natural food availability and human use are discussed.

I would like to thank Glacier National Park for allowing me to conduct much of the research while I was a ranger. Additional funding for this and other research incorporated in 2 separate papers was received by the National Wildlife Federation, the National Rifle Association, the National Parks and Conservation Association, and the Max McGraw Wildlife Foundation. I would like to thank C. Servheen, B. O'Gara, D. Pletscher, K. Foresman, C. Martinka, and C. Jonkel for helpful comments and review of the manuscript. I would also like to thank ranger S. Frye for help in many aspects of the study, and rangers K. Wilson, J. Johnson, B. Litchfield, K. Pitt, and many others for help in gathering data. The Belton Chalet's management, L. Luding and K. Larson, were very cooperative. The Montana Cooperative Wildlife Research Unit and the U.S. Forest Service also helped in many logistical aspects of this and other related research.

STUDY AREA AND METHODS

Glacier National Park is located in northwestern Montana and is characterized by high relief mountainous

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[1] Present Address: Powell Ranger Station, Lolo, MT., U. S. 59847.

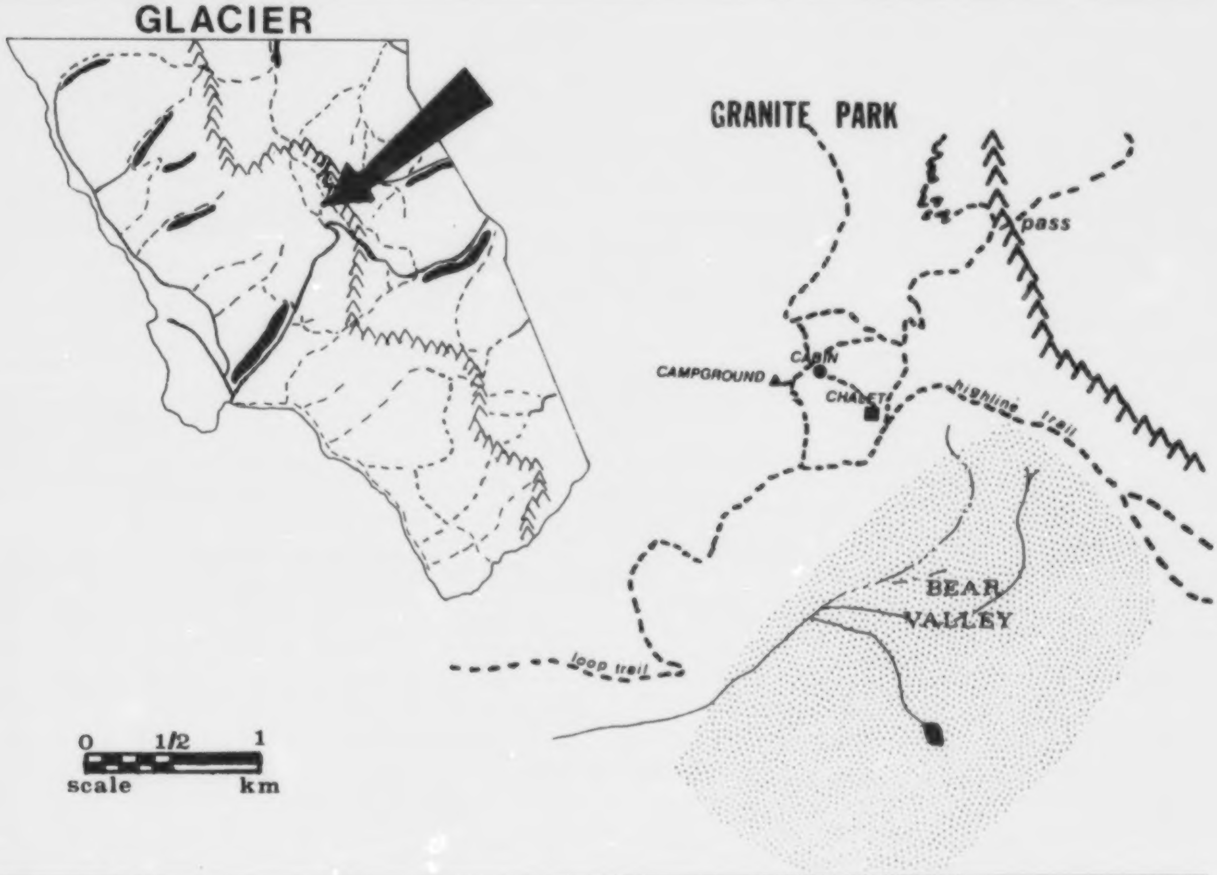

Figure 1. Study area.

terrain and a continental climate. Freezing temperatures and snow can occur in any month. A more detailed description of Glacier Park can be found in Martinka (1974) and McArthur (1982). Research was conducted in the central portion of the park in a 6.5-km^2 area of Granite Park and in an area locally known as Bear Valley (Figure 1). Common habitat types (Pfister et al. 1977) include subalpine fir (*Abies lasiocarpa*) /beargrass (*Xerophylum tenax*)-globe huckleberry (*Vaccinium globulare*) (Abla/xete-vagl), and subalpine fir/woodrush (*Luzula hitchcockii*) (Abla/luhi). The majority of habitats remain in early successional stages due to wildfires in the area during 1936 and 1967 and annual spring snowslides (McArthur 1982). Elevations in the study area range from 1,700 m to 2,500 m.

A network of intensively used day-hike trails, a campground, a trail cabin, and a back-country chalet are located in the study area. The campground has a nightly limit of 4 parties, the chalet houses 48 guests and 9 employees, and the trail cabin houses the Ranger and Trail crew. The chalet overlooks a bench area of prime grizzly habitat called Bear Valley, where more grizzly sightings occur annually than in any other area of similar size in Glacier Park (Glacier Park, unpubl. data).

Nocturnal Methods

Nocturnal research was conducted for 47 nights during September 1982 and 1983, and for 15 nights from 4 July through 31 August 1983. Bear movements through the campground area were analyzed using an intensive grid census technique. Grids varied in size depending on the width of the trail, but averaged 1 - 1.5 m^2. Grids were placed on hiking trails and game trails in areas of expected bear use, and randomly distributed along trails within 1 km of the campground as well as in the campground. The grids were raked at sunset and checked for tracks shortly after sunrise. Tracks were measured to determine relative age/sex class (adult and subadult combined, and female with young). A starlight scope was used on clear nights during September 1982. Observations were conducted from the upper porch of the chalet, which provided a good view of most of the campground and open areas near the chalet. Observations were conducted for 15 minutes hourly from dark until about 0100 hours, then every 2 hours until dawn. The starlight scope was not used in 1983 or 1984. A daily survey was also conducted in search of scats, tracks, diggings, or other bear sign in areas likely to receive use.

Diurnal Methods

Intensive data on diurnal observations were recorded for 27 days during September 1982, and for 84 days from 4 July through 26 September 1983. These data included date, time, weather (temperature, relative humidity, cloud cover, wind speed and direction, precipitation), bear description, location (plotted on a 15 minute topographical map) and direction of travel, bear's distance to chalet, trail, and campground, and number of people present in the campground. Detailed notes were recorded on bear behaviour and interactions with conspecifics, humans, and other animals. Data on bears near the chalet, collected by the Bear Management Rangers stationed at the chalet in 1984, were also used. Reports of 129 bear groups were used in these analyses.

Habitat Availability and Use

In September 1982, huckleberry availability was mapped by hiking through the study area once a week and investigating huckleberry production at different aspects, elevations, and slopes in a 0.5 km perimeter around the campground. A 0.5 km transect with 10 marked huckleberry bushes was positioned directly downslope of the campground to determine huckleberry production and development. When 70 to 90% of the berries on the marked bushes were purple, they were considered ripe. The same transect was used in 1983 to compare phenology and production between years. In addition, data was used from a berry productivity study that was conducted parkwide by the Park research staff (Kendall 1986).

Vegetation in the Granite Park Area including Bear Valley was mapped at scale 1:24,000 in 1985 using recent Forest Service methodology (Hann 1985). Fifty-two habitat and physical feature variables were documented at 30 separate 404-m^2 (0.1-acre) plots. Each plot was characteristic of a specific habitat component chosen with the use of aerial photos and ground surveys (Hann 1985). Habitat maps were overlaid with locations of grizzly observations to determine observed use of habitat in the study area.

Observation data were entered into the University of Montana DEC20 computer system and analyzed using 1022 data base management (Jackson 1982). Differences in habitat use between years, and other distributions, were compared using the G-test (Sokal and Rohlf 1981) and the Chi-square test.

RESULTS AND DISCUSSION

Habitat Use in Bear Valley

Analyses of grizzly bear observations in Bear Valley indicated significant shifts in use of habitat components among months ($P<0.001$). Grizzlies foraged in 4 major areas of Bear Valley (Figure 2), and 3 general foraging strategies were recognized: digging for bulbs and corms, foraging for forbs, and foraging for berries. These feeding activities were roughly stratified into 3 seasonal periods: (1) July - digging for bulbs and corms, (2) August - foraging on forbs, digging for bulbs and corms, and (3) late August-late September - foraging on berries, digging for bulbs and corms.

Once snow had receded enough to expose glacier lily and spring beauty fields, bears arrived in the area and began digging corms and bulbs. Glacier lilies were abundant (10 to 50% cover) in all habitat components in Bear Valley and extensive digs were noted throughout the area for lilies and spring beauties. Although spring beauties were not as abundant as glacier lilies, they were available in most components and in some areas comprised 50% cover. Although components used in July differed among years, they were not significantly different ($P<0.05$) (Table 1).

Bear Valley has poor drainage with a slow winding stream and 2 ponds. This hydric influence creates an area of dense willow (*Salix* spp.) (80% cover), lush dense grass (*Graminae* spp.) (70% cover) interspersed with dense horsetail (*Equisetum arvense*) (70% cover), glacier lily (10% cover), and wild onion (*Allium* spp.) (5% cover). Thirty-one percent of the observations of

Table 1. Observations of grizzly bears in major foraging areas in Bear Valley, Glacier National Park, Montana.

	FORAGING AREAS												
	1[a]			2[b]			3[c]			4[d]			
Year	July	Aug	Sep	July	Aug	Sep	July	Aug	Sep	July	Aug	Sep	Totals
1982	10	2	1	1	4	7	5	2	0	1	0	10	47
1983	16	5	0	0	4	0	0	5	4	1	0	14	49
1984	11	7	0	1	3	2	3	3	2	0	0	1	33
Totals	37	14	5	2	11	9	8	10	6	2	0	25	129

[a] Habitat components were Shrubfield/Forbfield and Huckleberry Shrubfield. Major foods were glacier lily, spring beauty, grass, and huckleberries.

[b] Habitat component was Riparian Streambottom. Major foods were horsetail, grass, and wild onions.

[c] Habitat components were Huckleberry Shrubfield, and Timbered Shrubfield. Major foods were huckleberries, glacier lily, and spring beauty.

[d] Habitat components were Huckleberry Shrubfield and Timbered Huckleberry. Major food was huckleberries.

bears feeding in Bear Valley during August occurred in these hydric sites, and the rest were in glacier lily and huckleberry dominated areas. Ninety-three percent of the bears observed feeding in these hydric sites were seen during August and September.

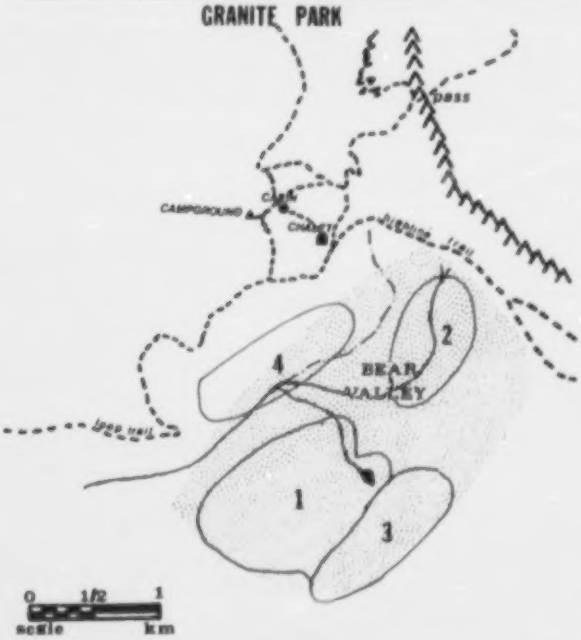

Figure 2. Four major foraging areas used by grizzly bears in Bear Valley. Habitat component breakdown is in Table 1.

Huckleberry production and development varied greatly among years, resulting in significant differences in use of habitat by bears ($P<0.001$). Habitat use during September varied significantly ($P<0.0.25$) among total years.

Huckleberries were most abundant, but ripened latest, in 1982. Huckleberry production decreased in 1983, but the berries ripened about 1 week earlier than in 1982. Production was lowest in 1984, but berries ripened almost 3 weeks earlier than in 1982. Those trends were consistent parkwide, as production decreased 61% from 1982 to 1983, and another 60% from 1983 to 1984 (Kendall 1985). As a result of the abundance of the berries in 1982, 84% ($N=30$) of the bears in and near Bear Valley during September were observed feeding in huckleberry shrubfields. During 1983, huckleberry production was moderate and localized; therefore bear observations were concentrated in specific, smaller areas of Bear Valley where berries were most abundant. Bears were also frequently observed digging glacier lilies and spring beauties. The extremely poor huckleberry year in 1984 caused bears to use other foods. Of the 5 bears reported, all were either digging or investigating, and the usual congregation of bears feeding on huckleberries during September was not observed.

Visitor Use

Three major trails received intensive use by visitors in the Granite Park area: the Highline, Loop, and Swiftcurrent Pass trails (Figure 1). Day use by visitors in the area was documented during 1980 and 1981, and reportedly peaked during late July and early August (McArthur 1982). More than 200 hikers were counted during a 3-hour period along a 12-km section of the Highline Trail during early August. Most hikers never walked as far as the chalet. Overnight use at the Granite Park Campground was highest during August, although use varied between years. No more than 4 parties of 4 people each were allowed at the campground in one night. Annual overnight use from 1982 through 1984 was 663, 515, and 445 visitor-use nights respectively, an overall reduction of 33% in 3 years. Use of Granite Park Chalet remained relatively constant among years throughout the peak season with a nightly average of about 30 guests and 9 employees (Belton Chalets, pers. commun.). Visitor use was restricted mostly to trails, and off-trail visitor use of Bear Valley was negligible throughout the summer.

Diurnal and Crepuscular Bear Activity

The sex/age composition of grizzly bears observed at Granite Park was significantly different than that observed for the overall park population ($P<0.05$) (Martinka 1974, McArthur 1982, Nadeau 1987). Females with young comprised a larger proportion of bears observed in Bear Valley (40%) than in the parkwide population (29%) (McArthur 1982, Nadeau 1987). Most observations during the day occurred in Bear Valley. Bear movements within 0.5 km of the chalet were 81% crepuscular ($N=31$), occurred either before 1000 hours or between 1800 hours and dark. Only 6 (19%) of the 31 bears observed travelled through the area between 1100 and 1700 hours. Of the bears observed travelling within 0.5 km of the chalet during daylight, 39% were subadults, 42% lone adults, and 13% females with young.

Nine (75%) of the 12 grizzly bears observed within 0.25 km of the campground during daylight were seen before 1000 hours or between 1800 hours and dark. Of these, 6 (50%) were subadults, 5 (42%) long adults, and 1 (8%) was a female with young. Likewise, 77% of the bears that came within 0.5 km of the campground during daylight did so before 1000 hours and between 1800 hours and dark ($N=26$). Of these, 42% were subadults, 23% lone adults, and 31% females with young. Although differences in sex/age proportions were not significant between distances ($P=0.22$), females were generally observed further away from the campground.

Bears travelling near the chalet/campground area in daylight typically used 3 travel routes (Figure 3). These routes connected Swiftcurrent Pass and Bear Valley, as well as Bear Valley and the bench area to the west and north of the campground. These routes were characterized by gently sloping timbered draws along travel routes, and timbered corridors around human activity. There was no relationship between weather conditions and the days bears were within 0.25 km of the chalet.

Nocturnal Bear Activity

Bears that travelled within a 0.5 km radius of the chalet/campground area came closer to the campground at night than during the day. Bears were documented travelling through and investigating the campground at night 5 times from 1982 through 1983 when campers were not present. Only once from 1977 through 1985 was a grizzly documented investigating the campground when people were present. That was a subadult that had been frequently seen in the area, and on that occasion it walked through the campground just prior to dark. Nocturnal bear activity within a 0.5 km radius of the chalet/campground area increased during September, but not significantly ($P=0.16$). Detectable bear activity in the chalet/campground area occurred only 20% of the nights sampled ($N=15$) during July and August. However, bear activity was documented on 40% of the nights sampled during September ($N=47$). Increased nocturnal bear activity near the campground during September may have been a response to the decrease in visitor use of the area combined with ripening of huckleberries.

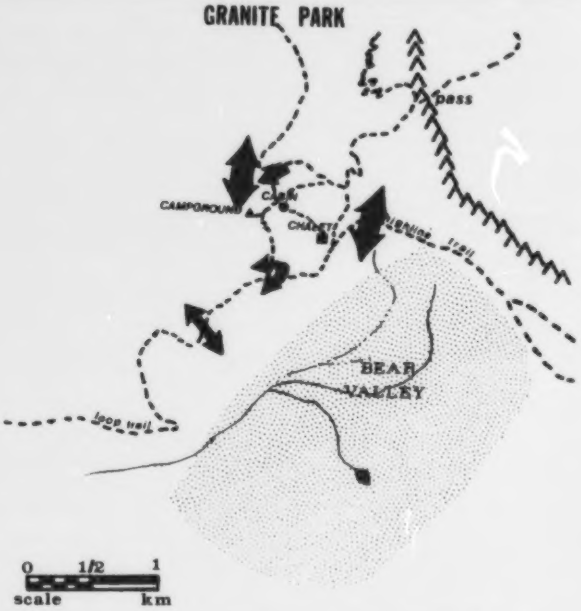

Figure 3. Diurnal and crepuscular grizzly bear movements and relative abundance of grizzlies using travel routes around Granite Park, 1982 through 1984. The wider the arrow, the greater the bear activity. The triangle designates the campground.

Thirty percent of the bears travelling through the area (<1 km from chalet) at night ($N=30$) were females with young, and 70% were either subadults or adults. These ratios were not significantly different from diurnal observations that occurred either parkwide or at Granite Park. Females used the area more frequently at night than during the day.

In general, bears tended to come from the Bear Valley area and move in a northwesterly direction past the campground. On nights when bears investigated the campground, ($N=5$), they usually approached from the southeast (Bear Valley) and moved through in a northwesterly direction, then headed down slope below the campground (Figure 4). Bears travelling through the area at night frequently travelled along trails (Figure 4). The campground trail passes within 4 m of one tent site, and on at least 2 occasions, a grizzly walked down the trail past a tent, outside of the designated campground, without stopping to investigate. Bears walked up the loop trail (*N*=6), and tracks were found going every direction across the loop trail, especially at a preferred nocturnal crossing route near the campground trail junction.

Although bear activity in the campground area increased at night, it was not clear whether this resulted from the increased cover available from darkness (Servheen 1981), or from the reduced levels of human activity. Increased nocturnal activity along roads near the Flathead River was noted when diurnal vehicular activity was intensive (McLellan 1986).

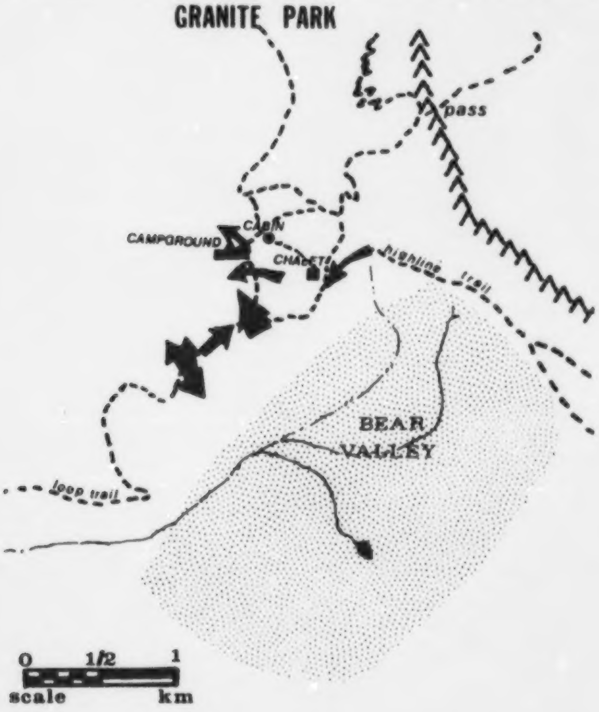

Figure 4. Nocturnal grizzly bear movements and relative abundance of grizzlies using travel routes around Granite Park, 1982 and 1983. The wider the arrow the greater the bear activity. The triangle designates the campground.

Prior to 1984, the campground regulations sign was constructed of wood. Bears entering the campground invariably knocked the sign down and bit or clawed it. Such marking behaviour occurred frequently on wooden signs throughout the park. At one nocturnal crossing site, subalpine fir trees had been bitten and broken off at varying heights. That appeared to have occurred over a number of years, and may indicate "marking tree" behaviour that is more commonly found at lower elevations.

During 1982 and 1983, 41% (*N*=22) of the bears that travelled through the chalet/campground area (<0.5 km from chalet or campground) did so on partly cloudy nights or nights clearing after a storm. Thirty-six percent travelled through on nights when the weather was dominated by snow or rain, and only 23% travelled through on clear nights. During September 1982, 92% (*N*=13) of the bears travelled through the area on nights that were at least partly cloudy. Because nocturnal weather data were not available, no comparison with weather during nighttime movements was possible. The starlight scope did not function effectively on cloudy nights, and as a consequence, no bears were observed. However, track data suggested that bears moved more frequently immediately following a change in weather, especially during the clearing phase after a storm, than at other times.

Bear Management at the Chalet

A Bear Management Ranger was stationed at Granite Park every night that the chalet was open, and throughout most of September after the chalet closed for the season. The Ranger's major duty was to patrol the campground area at least twice daily to ensure that campers had properly prepared and stored their food. The Ranger also educated the campers and chalet guests on proper camping techniques in grizzly country, and often spoke on bear ecology while viewing bears in Bear Valley. When bears were seen in the chalet/campground area, the Ranger ensured that people remained distant from bears. Grizzly bear occurrence was continually monitored in the area in an effort to minimize potential bear-human conflicts.

Due to the high densities of grizzly bears and intensive nature of the human activities at Granite Park, bears in the area have become highly habituated. However, because bears have not been allowed to obtain human food since the late 1960's, they have not learned to associate humans with a food reward. This has resulted in a reasonably peaceful coexistence to date. The situation of bears travelling through the area at all hours may not be as dangerous as it first appears, provided vigilant monitoring efforts and predictable human use patterns are maintained. Similar grizzly-human interactions occur in Alaska at Katmai National Park and near the grizzly congregations along the McNeil River. Grizzly bear-human conflicts in these areas have been kept to a minimum through active bear monitoring, people management, and an inherent adaptability among bears.

In contrast, campgrounds that are not intensively monitored may be more dangerous despite lower levels of grizzly bear activity in the area. On frequent occasions, Rangers patrolling back-country campgrounds have observed improperly stored food and inappropriate camping techniques. Once a bear obtains a food reward, the conditioning process is reinforced and the animal may then become more dangerous (Herrero 1985). From 1967 - 1986, 4 of the 6 human deaths in Glacier National Park were inflicted by bears that were known to have obtained garbage. The remaining 2 incidents were believed to have involved food-conditioned bears as well (Glacier Park, unpubl. data).

SUMMARY AND CONCLUSIONS

Habitat use and distribution of grizzly bears in Bear Valley varied among months and years. Variations were most closely associated with temporal fluctuations in huckleberry production and phenology. Bears tended to use the trails more frequently and ventured closer to the campground and chalet area at night and during September than at other times. Females with young used the trails and ventured closer to the campground and chalet area more frequently at night and during crepuscular periods than during the day, suggesting temporal resource partitioning in response to intensive visitor use. Bears (with the exception of 1 subadult) avoided entering the campground when people were present but frequently travelled through when people were absent. Vigilant bear monitoring and intensive management and education of people seem to be effective in preventing dangerous interactions between grizzly bears and humans in an area used intensively by both species.

LITERATURE CITED

HANN, W. 1985. An integrated system for the grizzly bear component mapping and description process, "The Quick Plot". U. S. Dept. Agric., U.S. For. Serv. Tech. Manual, Missoula, Montana. 22 pp.

HERRERO, S. 1985. Bear attacks; their causes and avoidance. Winchester Press, Piscataway, N.J. 287 pp.

JACKSON, K. 1982. Primer, system 1022, data base management system. Software House, Cambridge, Mass. 141 pp.

KENDALL, K. C. 1985. Grizzly bear population trend studies in Apgar Mountains, Glacier National Park. Natl. Park. Serv. Progr. Rep., Glacier Natl. Park, Montana. 23 pp.

_____. 1986. Grizzly and black bear feeding ecology in Glacier National Park, Montana. Natl. Park Serv. Prog. Rep., Glacier Natl. Park, Montana. 42 pp.

MARTINKA, C. J. 1974. Population characteristics of grizzly bears in Glacier National Park, Montana. J. Mammal. 55:21-29.

McARTHUR, K. L. 1982. Interactions between grizzly bears and hikers in Glacier National Park, Montana. M.S. Thesis, Oregon State Univ., Corvallis. 100 pp.

McLELLAN, B. N. 1986. The effects of roads and motorized vehicles on grizzly bears in the North Fork of the Flathead River, B.C. unpubl. rep. Dept. of Animal Science, Univ. of B.C., Vancouver, B.C. 51 pp.

NADEAU, M. S. 1987. Habitats, trails, and campground situations associated with grizzly bear-human confrontations in Glacier National Park, Montana. M.S. Thesis, Univ. Montana, Missoula. 98 pp.

PFISTER, R., B. KOVALCHIK, S. ARNO, and R. PRESBY. 1977. Forest habitat types of Montana. U.S. For. Serv. Gen. Tech. Rept. INT-34. 174 pp.

SERVHEEN, C. 1981. Grizzly bear ecology and management in the Mission Mountains, Montana. Ph.D. Thesis, Univ. Montana, Missoula. 138 pp.

SOKAL R. R., and F. J. ROHLF. 1981. Biometry. Second ed. W. H. Freeman and Company, New York. 859 pp.

DEMOGRAPHIC CONSEQUENCES OF BEARS EATING GARBAGE AT DUMPS: AN OVERVIEW

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Abstract: The demographic consequences of bears eating at dumps are complex and in some respects contradictory, as is also true for the consequences of dump closure. Calculation of net consequences requires a simulation model. Digestible lipids, carbohydrates, and protein seem more abundant in garbage than in most natural diets of bears. Eating garbage tends to increase body size and rates of reproduction and survival, and may affect local ingress and egress. At dumps, juveniles may be particularly vulnerable to being killed by conspecifics, and bears of all ages are especially vulnerable to hunters. Closure of a dump could reduce reproductive rate, the number of juveniles killed by other bears, and the number of bears killed by hunters, while conversely increasing the number of bears undernourished or killed as nuisances. Data are available from so few, sparsely documented, cases of dump closure that we do not know which closure methods are best or precisely what impacts to expect from each method. When dumps are to be closed, a variety of methods should be used so that impacts can be assessed and alternatives tested under a policy of "adaptive management".

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Throughout North America, grizzly bears (*Ursus arctos*), black bears (*Ursus americanus*), and polar bears (*Ursus maritimus*) supplement their diets with human foods (Craighead et al. 1974; Jonkel et al. 1976; Rogers 1976, 1987; Rogers et al. 1976; Craighead 1979; Herrero 1983; Bruemmer 1984). Bears obtain food from humans by scavenging garbage at dumps; raiding garbage containers, camps, or buildings; stealing food directly from people or being given handouts by people. This paper focuses on the role of feeding at dumps, and on the effects of such feeding and of dump closure on bears and bear-people interactions.

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POPULATION DYNAMICS

The demographic consequences of bears eating garbage or of garbage dump closure are complex and in some respects contradictory. To predict reliably the net direction of demographic change (e.g., whether population density will increase or decrease), and especially to estimate the amount of change, requires a simulation model. Data are needed on sex/age-specific rates of growth, reproduction, migration, and survivorship, as well as on population density, sex-age infrastructure, social organization, and availability and nutritional quality of natural foods and garbage.

Nutritional Value of Garbage

It is a common impression (Rogers 1976, 1987; Rogers et al. 1976; Blanchard 1987; Craighead, pers. commun.) that garbage is richer than most natural diets of bears in calories, simple carbohydrates, lipids, and meat protein. However, there has been no formal analysis of how well human food eaten by bears meets their nutritional requirements.

Individual Differences In The Amounts of Human and Natural Foods Eaten

Barnes and Bray (1967) and Cole (1976) claimed that among black and grizzly bears in Yellowstone National Park, "dump bears" were typically distinct from "wild" ones. However, available data from this and other publications reveal not a dichotomy but a gradient in use of dumps by different individual bears or sex/age classes, ranging from regular use for virtually the entire season, to rare use, to none at all (Craighead et al. 1974; Craighead 1979; Herrero 1983; Blanchard 1987; L. Rogers, pers. commun.; D. Garshelis, pers. commun.; Stringham unpubl. data). I have found no substantive basis for distinguishing "dump bears" as a class except that they are bears which have visited a dump, and have been exposed to conditions peculiar to dumps, such as abundant garbage, more than other bears. That is how the term "dump bears" is used here.

At some dumps and some concentrations of natural food, subadult and/or adult males seem disproportionately abundant, whereas females with cubs seem rare (black bears: L. Rogers, pers. commun., Stringham unpubl. data; polar bears: Taylor et al. 1985). However, other sites are more commonly frequented by females and cubs (black bears: Herrero 1983; D. Garshelis, pers. commun.; grizzly bears: Egbert and Stokes 1976; Glenn et al. 1976; Craighead 1979). Among black bears in central Minnesota, Garshelis (pers. commun.) found that females were most common at a dump before the breeding season, whereas males gradually became predominant during and after the season. He did not state what proportion of these males were subadults.

More research is needed on how the number and sex/age composition of bears at a food concentration vary diurnally, and on how these traits are affected by density/size and sex/age composition of the whole population and by abundance of garbage in relation to natural foods. Information can be obtained with automatic telemetric monitors at garbage dumps which record 24-hour visitation by radio-collared bears, as Garshelis is doing in Minnesota.

Body Size

Energy and protein usually limit rates of growth and reproduction by mammals (Sadlier 1969, Stringham 1988*b*). Bears eating human food can attain especially high growth rates and adult body sizes. In Alaska, captive-reared black bears grew about twice as fast and reached maximum adult sizes about 50% larger than wild black bears (Rausch 1961).

In Michigan, the average weights of adult black bears at dumps were heavier (males 22%, females 57%) than those captured at campgrounds or residential areas (Rogers et al. 1976). Similar results were reported by Russell et al. (1979) for grizzly bears in Jasper National Park, Alberta.

After dumps in Yellowstone National Park and West Yellowstone were closed during 1968-1971 (Cole 1976), body weights of adult grizzly bears fell about 22% for males and 11% for females (comparing data of Craighead and Mitchell 1982 with Blanchard 1987; see Stringham 1985). Smaller sources of garbage remained for several more years. Adults that ate garbage weighed more than those that did not, (males 15%, females 6%). Among females, the weight difference was greatest for those with cubs of the year, less for those with yearlings, and negligible for those unaccompanied by offspring (Blanchard 1987). Weights of grizzly bears feeding at the Cooke City dump, north of Yellowstone National Park, declined after the dump was closed in 1980 (Knight and Eberhardt 1985). Apparently the natural food supply limited the size of those bears -- a situation that may not exist in some other habitats. Regressions of population means for natality, litter size, interbirth interval, and age at primiparity on mean sizes of adult males and females show that reproductive rate is directly related to size in both grizzly and black bears (Stringham 1986*b*, 1988*b*). Correspondingly, bears that feed on garbage are not only larger, but tend to have higher reproductive rates.

Reproductive Rate

In bears, as in other mammals (Sadlier 1969, Stringham 1988*b*), elevated nutritional status tends to accelerate maturation to weaning, and dissociation from the dam (subadulthood), and to adulthood. In northeastern Minnesota, where natural food is often scarce, black bears with access to garbage matured earlier (4.4 years) than those on predominantly natural diets (6.3 years) (Rogers 1987). In central Minnesota, where natural food tends to be more abundant, females that regularly fed at a dump first whelped at age 4, compared to age 4 or 5 years among females on predominantly natural diets (D. Garshelis, pers. commun.). For Yellowstone grizzly bears, maturation rate dropped when garbage dumps were closed, with age at primiparity (generation length) increasing 10% from 5.6 years during 1959-1970 (Craighead et al. 1976) to 6.2 during 1974-1984 (Knight & Eberhardt 1985).

Cole (1976) noted that mean age at primiparity was about 6 years at Yellowstone (1959-1970) and at McNeil Falls in Alaska (Glenn et al. 1976). That is longer than at some other sites where natural food is abundant, for instance on the Alaskan coast (Hensel et al. 1969, Stringham 1988*b*). Cole (1976) hypothesized that the slower maturation rate at Yellowstone and McNeil was due to more intensive social strife as a consequence of the bears aggregating in large numbers to feed on garbage or salmon, respectively. However, the data just reviewed show that maturation rate at Yellowstone National Park slowed, not accelerated, when the Yellowstone dumps were closed. Furthermore, the difference in maturation rates among populations seems adequately explained by just nutritional status, judging from a regression of generation length on body weight (an index of nutritional status) across 12 grizzly populations (Stringham 1986*b*, 1988*b*).

Following closure of the main Yellowstone dumps during 1968-1971, mean cub litter size for the population decreased from 2.24 in 1959-1968 to 1.87 in 1972-1981 (data of Craighead et al. 1974, Cole 1976, and Knight et al. 1985 analyzed by Stringham, 1985, 1986a, 1988a,b); about 70% of the decrease is attributable to dump closure and 30% to climatic conditions. In later years, females that fed at the remaining, smaller dumps averaged 2.17 cubs per litter, compared to 1.92 cubs for females that did not feed at dumps (Blanchard 1987). On the Upper Peninsula of Michigan, cub litter sizes averaged 3.1 at dumps during a study by Rogers et al. (1976), compared to 1.99 elsewhere on the Peninsula during research by Erickson et al. (1964). Rogers et al. (1976) attributed the difference in litter size to garbage feeding. However, differences in natural food supply and in methods of assessing litter size should also be taken into account. In northeastern Minnesota, where natural food is often scarce, mean litter sizes averaged 2.12 for primiparous mothers and 2.51 for multiparous mothers that ate natural diets, compared to litter sizes of 2.50 and 3.4 for primiparous and multiparous mothers, respectively, that also ate garbage (Rogers 1987). In central Minnesota, by contrast, where natural food is usually more abundant, females on predominantly natural diets produce litters as large as those that regularly eat garbage (D. Garshelis, pers. commun.). The positive correlation between postnatal litter size and food supply is well documented in bears, apparently resulting from positive influences of nutritional status on natal litter size and postnatal survivorship (Rogers 1976; Stringham 1985, 1986*a*, 1988*a,b*).

Both the proportion and number of adult females whelping each year are directly related to natural food supply (Jonkel and Cowan 1971; Rogers 1976, 1977; Eiler 1981; Wathen 1983) or combined supplies of natural and human foods (Stringham 1985, 1988*b*). Interbirth interval tends to be inversely related to food supply because better-nourished cubs tend to mature faster (Stringham 1980, 1988*b*). Poorly-nourished cubs may remain with their dam for an extra year, lengthening the interbirth interval from 2 years to 3 years in black bears (Jonkel and Cowan 1971) and up to 4 years in grizzly bears (Reynolds 1976). Conversely, some exceptionally well-nourished black bear cubs might grow fast enough to quit nursing before half-a-year old, allowing the mother to mate then and reduce her interbirth interval to 1 year (D. Garshelis, pers. commun., G. Alt, pers. commun.). Intervals tend to be shorter for females that eat garbage than those that do not, as documented for Minnesota black bears (2 versus 2.3 years) (Rogers 1987) and Yellowstone grizzly bears after the main dumps had been closed but smaller ones remained open (2.5 versus 3.6 years) (Blanchard 1987).

There is also a counter-tendency for a positive correlation between interbirth interval and food supply, where better- nourished litters have higher survivorship, so that fewer interbirth intervals are terminated prematurely by entire-litter mortality. The effects of nutritional status on litter survival, dominating the effects on maturation rate, apparently explain the positive correlation between interbirth interval and food supply found for Yellowstone grizzly bears during 1959-1981 (Stringham 1985, 1988*b*).

Survival Rate

Positive correlations have been shown between survivorship of cubs and older immatures versus body weight or indices of natural food supply for black bears (Rogers 1976, 1983, 1987), or versus combined supplies of natural foods and garbage for grizzly bears (Stringham 1985, 1988*b*).

Even though litter size tends to be directly related to nutritional status (Stringham 1985, 1988*b*), a larger litter sometimes occurs at the expense of smaller cubs (Miller 1963, Alt 1980, Wathen 1983). Unless a rich diet increases nutritional status not only for the mother, but also per cub, the smaller cubs from larger litters may remain runts indefinitely and have lower survivorship (Rogers 1976). Conversely, reduction in food supply, which lowers litter size and adult body sizes, might sometimes increase mean body size for juveniles (Stringham 1985, 1988*b*). Further study is needed to determine how food supply affects survivorship relative to litter size.

Cole (1976), Glenn et al. (1976), and others have argued that mortality rates of juveniles might be elevated at dumps and at natural sites where bears aggregate to feed. This theory is based on changes in mortality rate observed when a dump was closed, observations of mortality at feeding aggregation sites, and higher estimates of mortality rate in populations that aggregate. Mortality rate for Yellowstone grizzly cubs apparently fell after the dumps were closed, despite declines in sex/age-specific body weights (data of Craighead et al. 1974 were compared with those of Knight et al. 1985 by Stringham 1988*b*, unpubl. data).

Some grizzly cubs are killed by conspecifics at aggregation sites, perhaps because of elevated social strife due to crowding or food competition, and/or to the increased exposure of the cubs to dangerous conspecifics. That may be why females with cubs of the year tend to avoid aggregations, especially during the spring and early summer, before the cubs are sufficiently swift and agile to outrun enemies. The same thing happens in polar bears (Taylor et al. 1985). Among black bears, the vulnerability of cubs at aggregation sites may be reduced by the ability of cubs to climb trees to escape enemies, and the practice by some females of leaving their cubs in trees on the periphery of an aggregation site (L. Rogers, pers. commun.; Stringham, unpubl. data). Observations should be made to learn whether the availability of large trees near a dump, especially easily climbed ones with rough bark such as hemlock (*Tsuga canadensis*) or white pine (*Pinus strobus*) (L. Rogers, pers. commun.), influences the tendency of females with cubs to feed there. This influence might be less important as cubs mature and are better able to outrun enemies.

Among grizzly bears, the decline in mean litter size between cub and yearling ages was about 5-fold higher in 2 populations (Yellowstone and McNeil) where large numbers of bears aggregated than in 16 populations where the bears were normally more dispersed and formed only small aggregations, if any (Cole 1976, Glenn et al. 1976, Stringham 1988*b*). Cole (1976) and Glenn et al. (1976) interpreted this as evidence that cub mortality rates were correspondingly elevated at Yellowstone and McNeil. However, more reliable estimates of cub mortality rate, based on relative numbers of cubs versus yearlings, suggest that grizzly cub mortality rate is not related to size of the feeding aggregation (Stringham 1988*b*). Studies by Egbert and Stokes (1976) showed that strife among grizzly bears at McNeil Falls tended to decline as the bears became more familiar with one another over the course of the annual salmon fishing season. This was overlain by an inverse relationship between strife and salmon abundance, with strife tending to increase again as the salmon run waned. Further studies need to be made of how duration of aggregation and food supply affect the intensity of strife and how much habituation carries over between years for bears that survive and return -- something that might be inversely related to hunting pressure.

We also need to determine whether rates of mortality and illness for adults are elevated at dumps. Dump bears seem particularly vulnerable to hunters (J. O'Pezio, pers. commun.; D. Garshelis pers. commun.). There has been no study to determine whether bears suffer illness from ingesting food contaminated with toxins (e.g., household chemicals), trash (e.g., plastic), or pathogens from livestock or humans (e.g., trichinosis or canine adenovirus); however, bears seem more resistant to disease than most animals (Rogers 1983, 1987). Perhaps the infrequency of aggregation impairs disease transmission. Any reduction in mortality or illness from these factors, when a dump is closed, could help compensate for any simultaneous increase in the number of bears killed as nuisances.

Density Of Adult Females

Cub production should be directly related to abundance of adult females unless this is impaired by density dependent negative feedback. Reduction in abundance of adult female following closure of the Yellowstone dumps seems to have had even more impact on cub production than did the decline in per capita reproductive rate (Craighead et al. 1974, Knight and Eberhardt 1985).

Density Of Adult Males

Breeding is not the only way in which densities of adult and subadult males can affect demography. Bears sometimes kill each other. Juveniles and subadults seem particularly vulnerable, especially to older males (Rogers 1983; Stringham 1985, 1988*b*; Taylor et al. 1985). Adult males might also control egress and ingress by juvenile and subadult males (Young and Ruff 1982). There was a negative correlation between abundance of adult males and cub production and survival among Yellowstone grizzly bears during 1959-1970 (Shaffer 1978, 1983; Stringham 1980, 1983, 1985, 1988b; McCullough 1981). This correlation might have resulted from any food competition between adult males and other bears, infanticide, and possibly impairment of female reproduction by the adult males (Stringham 1985, 1988*b*). A change in mortality rate for adult and subadult males could thus affect cub production or survival. We need to learn whether this relationship depends on the number or proportion of males from a population killed by hunters, on the social ranks of these males, or on their kinship to the dams and cubs.

In at least some primates, sires of resident young are less likely than other males to kill these young or inhibit reproduction by resident females (Hrdy 1979). If the same were true in bears, then harvest of resident adult male bears might allow resident subadult or immigrant males to impair female reproductive success, whereas harvest of subadult and transient males might have the opposite effect (Stringham 1985, 1988*b*).

Simulation Modelling

The kinds of data discussed above should be incorporated into a simulation model for estimating the maximum tolerable declines in size and in growth rate for a bear population, as a basis for calculating the biologically and socially tolerable rates of dump closure. If the rate of closure cannot be controlled by the wildlife manager, the only means of ameliorating closure impacts might be providing supplemental food for the bears, choosing the season when closure occurs, changing harvest rate, and training (e.g., aversively conditioning) the bears to avoid humans or human food.

BEAR NUISANCE ACTIVITY: DIRECTIONS FOR NEW RESEARCH

Wildlife biologists have long had to deal with bear responses to garbage consumption and dump closure. But seldom has their practical experience been documented or the contradictions between their observations explained. Consider 2 examples: (1) Rogers (pers. commun.) noticed that towns and campgrounds in bear habitat of the Great Lakes region had less nuisance activity if there was a nearby dump where the local bears fed. Yet other biologists believe that dumps increase nuisance activity (J. O'Pezio, pers. commun.). None of these biologists has published data for the comparisons upon which their conclusions are based. (2) With black bears at the town of Tahawus in New York's Adirondack Park during the 1950's (R. Sage, pers. commun.), and with grizzly bears in Yellowstone National Park (Craighead 1979) a decade later, dump closure was followed by dramatic increases in nuisance activity and by resulting increases in the number of bears eliminated from the population by control actions. But we do not know how typical this is, how to predict strength of the impacts on bears or people, or how to control the impacts. Indeed, one can derive few reliable generalizations from available information about the consequences for bears and bear-people interactions of different methods of managing bears relative to dumps.

However, the available information does help one narrow the focus of research by asking more specific questions, as detailed below.

Abruptness Of Closure

Closure of garbage dumps at Yellowstone National Park caused a major reduction in the grizzly bear population (Craighead 1979), whereas closure of dumps in the Adirondack Park had no noticeable effect on its black bear population (J. O'Pezio, pers. commun.). The impact of closure might be directly related to the abruptness of closure, that is to the proportion of the population affected per year. In Yellowstone, the Trout Creek Dump was sometimes visited by over 100 grizzly bears a night, and commonly by over 30; most of the roughly 200 bears in Yellowstone fed on garbage at least occasionally (Craighead 1979). Thus most bears were directly affected by the abrupt closure over a 4-year period of both major dumps and 1 minor dump in the Park, as well as 1 major dump at the nearby town of West Yellowstone. The 2 municipal dumps north of the Park, at Gardiner and Cooke City, remained open several more years (Craighead 1979; Knight et al. 1981). By contrast, of the roughly 3,600 black bears in the Adirondack Park, only a small fraction seem to have been affected each year by dump closures. Closure of more than 100 dumps has been spread over the last 25 years (S. Free, pers. commun., J. O'Pezio, pers. commun.), and the number of bears feeding at each dump was apparently much smaller than at Yellowstone. Few of the hundreds of local residents and bear-watching tourists I questioned claimed to have seen more than 20 bears at any of these dumps, and usually no more than 5 to 10 bears. During 1987, only about 10 Adirondack dumps were still open to bears. The 2 dumps that I monitored were each visited by no more than 12 bears between morning and midnight, and apparently by few if any other bears during rest of the night (Stringham, unpubl. data). It is not known how the amount of garbage available to bears in the Adirondacks compared with that at Yellowstone.

Is feeding on garbage sometimes traditional, learned by cubs from their mother? Does gradual dump closure allow the trait to spread and thus to increase bear-people conflicts more than would abrupt closure (Cole 1976)? Conversely, does social intolerance among the bears or some other social factor limit use of dumps; does this limit shrink as garbage supply declines?

Habituation

It is a common belief that bears that fear people are unlikely to attack people or become nuisances, and that loss of fear through frequent contact with people - or habituation - makes them more dangerous. Habituation is facilitated where bears encounter non-aggressive people, for instance at a park or a dump. Proposals have been made to counter habituation by aversively conditioning or by hunting habituated bears, even in national parks.

Efforts to protect people from attack by bears should take into account the distinction between offensive and defensive attack (Herrero 1985). Offensive attack by an animal normally occurs in situations of dominance assertion or predation. Defensive attack is directed at enemies that seem dangerous, for instance a predator or competitor encountered by surprise at close range. Methods used to prevent offensive attack should not promote defensive attack. Skunks and porcupines deter attacks by engendering respect, by making enemies fear retaliation, not by making them fear aggression. So too, the chances that a bear will attack people either offensively or defensively might be minimized by teaching it to respect people rather than to fear them ("respect" and "fear" refer here to behaviours, not emotions).

How can a bear's fear of unprovoked human aggression be minimized without sacrificing the bear's respect for people? How do the consequences of a bear's habituation and respect towards people differ when developed at a dump, a campground, a roadside panhandling site, or in an area where the bear usually encounters only small groups of hikers or campers? Under what circumstances are bears habituated to people at a dump likely to become nuisances, either while the dump is open or after it has been closed? How specific are habituation and respect to the site/situation where they were learned?

Supplemental Feeding

If food for bears (e.g., concentrated edible garbage or ungulate carrion) is transported to sites removed from human activity, how effective is this at keeping the bears away from people, at optimizing habituation and respect, or at minimizing nuisance activities? Supplemental feeding at an isolated site was used to a limited degree during the Yellowstone dump closures (Cole 1976) and is planned in Minnesota (D. Garshelis, pers. commun.). How do the number, size, and distribution of nearby rich natural and/or artificial feeding sites influence the vulnerability of a developed area to nuisance activity by bears? How should each supplemental feeding site be situated relative to the developed area? How might supplemental feeding sites be designed as areas for viewing bears -- as is planned in Minnesota (D. Garshelis, pers. commun.) -- that enhance mutual respect by bears and people? If the supply of supplemental food will eventually be eliminated, how can it be reduced so as not to force the bears into nuisance activity? For instance, should each supplemental site be located in a prime natural feeding area that will continue to provide abundant food after supplemental feeding ends? Should feeding be maintained/resumed when natural foods are scarce and bears are thus most likely to become nuisances (Hatler 1967; Rogers 1976, pers. commun.)? Should supplemental feeding be terminated abruptly or gradually?

Characteristics Of The Bear Population

How is the amount of nuisance activity resulting from dump closure related to social organization of the bears, their sex-age composition, and the size or biomass of their population relative to the natural food supply? Are immigrant bears, such as transient subadult males, more or less likely than resident bears to become nuisances? Under what circumstances does social intolerance towards immigrants by resident bears living near people minimize nuisance activity by the immigrants? Conversely, does social intolerance by conspecifics impede attempts by dump bears to readapt to natural patterns of feeding and habitat use, to "revert to the wild," after a dump is closed? Does "reversion" by dump bears meet less resistance from local bears that do not use dumps if only a few dump bears make the transition each year?

Harvest Of Dump Bears

Is nuisance activity after closure of a dump inversely related to the number or proportion of the dump bears soon killed by hunters? Under what circumstances is harvest the preferred method of minimizing nuisance activity?

Timing of Closure

What is the best season for reducing the supply of garbage or of supplemental food? Should it occur during hibernation, after some of the dump bears have been killed by hunters and "replacements" will not be lured to the dumps by garbage (J. O'Pezio, pers. commun.)? Or should closure occur during a season when surviving dump bears can adapt to the decline gradually? Is winter closure preferable in a region where most dump bears were harvested during the preceding autumn? Is summer closure preferable where hunting pressure is light?

Hypothesis Testing And Adaptive Management

Research to answer questions such as those posed above can be facilitated if potential answers are derived prior to new fieldwork and phrased as alternative hypotheses which can be tested by the fieldwork, according to the principles of Strong Inference (Platt 1964, Wilson 1975).

Where feasible, relationships between bears and dumps should be managed experimentally so that the consequences of alternative methods can be assessed. To optimize long-term management, the requirements of short-term management need to be balanced with those of research in selecting the array of bear-dump management methods (experimental protocols) to be tested. For example, one might test more extreme versions of management practices -- such as elimination of all versus none of the dump bears prior to closure - to determine how much effect this has on the subsequent levels of nuisance activity; these extremes can provide more information than tests made with just the particular management practices thought *a priori* to be best. Long-term policies should be adopted only after adequate data are in hand to predict and preferably control the consequences of each method. This is what Walters and Hilborn (1978) termed "adaptive management."

LITERATURE CITED

ALT, G. L. 1980. Rate of growth and size of Pennsylvania black bears. Pa. Game News. 51:7-17.

BARNES, V. G., AND O. E. BRAY. 1967. Population characteristics and activities of black bears in Yellowstone National Park. Natl. Park Serv. Rep., File YELL-67, YELL-N-13, Washington, D. C. 199 pp.

BLANCHARD, B. M. 1987. Size and growth patterns of the Yellowstone grizzly bear. Int. Conf. Bear Res. and Manage. 7:99-107.

BRUEMMER, F. 1984. How polar bears break the ice. Nature 93(12):38-47.

COLE, G. F. 1976. Management involving grizzly and black bears in Yellowstone National Park, 1970-75. Nat. Res. Rep. 9, U. S. Dept. of Inter., Natl. Park Service, 26 pp.

CRAIGHEAD, F. C., JR. 1979. Track of the grizzly. Sierra Club Books, San Francisco. 261 pp.

CRAIGHEAD, J. J., F. C. CRAIGHEAD, JR., and J. SUMNER. 1976. Reproductive cycles and rates in the grizzly bear, *Ursus arctos horribilis* of the Yellowstone ecosystem. Int. Conf. Bear Res. and Manage. 3:337-356.

_____, and J. A. MITCHELL. 1982. The grizzly bear. Pages 515-556 *in* J. A. Chapman and G. A. Feldhamer, eds. Wild mammals of North America. Johns Hopkins Univ. Press, Baltimore. 1147 pp.

_____, J. R. VARNEY, AND F. C. CRAIGHEAD, JR. 1974. A population analysis of the Yellowstone grizzly bears. Montana For. and Conserv. Exp. Stn. Bull. 40, Univ. Montana, Missoula. 20 pp.

EGBERT, A. L., AND A. W. STOKES. 1976. The social behavior of brown bears on an Alaskan salmon stream. Int. Conf. Bear Res. and Manage. 3:41-56.

EILER, J. H. 1981. Reproductive biology of black bears in the Smoky Mountains of Tennessee. M.S. Thesis, Univ. Tennessee, Knoxville. 128 pp.

ERICKSON, A. W., J. E. NELLOR, and G. A. PETRIDES. 1964. The black bear in Michigan. Agr. Exp. Sta. Res. Bull., Michigan State Univ., 4:1-102.

GLENN, L. P., J. W. LENTFER, J. B. FARO, and L. H. MILLER. 1976. Reproductive biology of female brown bears (*Ursus arctos*), McNeil River, Alaska. Int. Conf. Bear Res. and Manage. 3:381-390.

HATLER, D. F. 1967. Some aspects in the ecology of the black bear (*Ursus americanus*) in interior Alaska. M.S. Thesis, Univ. Alaska, College. 111 pp.

HENSEL, R. J., W. A. TROYER, and A. W. ERICKSON. 1969. Reproduction in the female brown bear. J. Wildl. Manage. 33:357-365.

HERRERO, S. 1983. Social behaviour of black bears at a garbage dump in Jasper National Park. Int. Conf. Bear Res. and Manage. 5:54-70.

_____. 1985. Bear attacks: their causes and avoidance. Winchester Press, Piscataway, N.J. 287 pp.

HRDY, S. B. 1979. Infanticide among animals: a review, classification, and examination of the implications for the reproductive strategies of females. Ethol. and Sociobiol. 1:13-40.

JONKEL, C. J., and I. McT. COWAN. 1971. The black bear in the spruce-fir forest. Wildl. Monogr. 27. 57 pp.

_____, I. STIRLING, and R. ROBERTSON. 1976. The polar bears of Cape Churchill. Int. Conf. Bear Res. and Manage. 3:301-302.

KNIGHT, R., B. M. BLANCHARD, and K. C. KENDALL. 1981. Yellowstone grizzly bear investigations. Ann. Rep. Interagency Study Team, 1980. U. S. Dept. Int., Natl. Park Serv. 54 pp.

_____, _____, and D. J. Mattson. 1985. Yellowstone grizzly bear investigations. Rep. Interagency Study Team, 1983 and 1984. U. S. Dept. Inter., Natl. Park Serv. 41 pp.

_____, and L. L. EBERHARDT. 1985. Population dynamics of Yellowstone grizzly bears. Ecology 66:323-334.

McCULLOUGH, D. R. 1981. Population dynamics of the Yellowstone grizzly. Pages 173-196 *in* C. W. Fowler and T. D. Smith, eds. Dynamics of large mammal populations. John Wiley and Sons, New York.

MILLER, R. S. 1963. Weights and color phases of black bear cubs. J. Mammal. 44:129.

PLATT, J. R. 1964. Strong inference. Science. 146:347-353.

RAUSCH, R. L. 1961. Notes on the black bear, *Ursus americanus* Pallas, in Alaska, with particular reference to dentition and growth. Z. Saugertierk. Bd. 26, H. 2:65-128.

REYNOLDS, H. V. 1976. North slope grizzly bear studies. Alaska Dept. Fish and Game, Final Rep., Fed. Aid Wildl. Rest. Proj. W-17-6 and W-17-7. 14 pp + App.

ROGERS, L. L. 1976. Effects of mast and berry crop failures on survival, growth, and reproductive success of black bears. Trans. North Am. Wildl. and Nat. Resour. Conf. 41:431-438.

_____. 1977. Social relationships, movements, and population dynamics of black bears in northeastern Minnesota. Ph.D. Thesis, Univ. Minnesota, Minneapolis. 203 pp.

_____. 1983. Effects of food supply, predation, cannibalism, parasites, and other health problems on black bear populations. Pages 194-211 *in* F. L. Bunnell, D. S. Eastman, and J. M. Peak, eds. Symposium on natural regulation of wildlife populations. Proceed. No. 14, For. Wildl. Range Exp. Stn., Univ. Idaho. 225 pp.

_____. 1987. Effects of food supply and kinship on social behavior, movements, and population growth of black bears in northeastern Minnesota. Wildlife Monogr. 97. 72 pp.

_____, D. W. KUEHN, A. W. ERICKSON, E. M. HARGER, L. J. VERME, and J. J. OZOGA. 1976. Characteristics and management of black bears that feed in garbage dumps, campgrounds, or residential areas. Int. Conf. Bear Res. and Manage. 3:169-175.

RUSSELL, R. H., J. W. NOLAN, N. W. WOODY, and G. ANDERSON. 1979. A study of the grizzly bear (*Ursus arctos L.*). Can. Wildl. Serv., Edmonton. 136 pp.

SADLIER, R. M. F. S. 1969. The ecology of reproduction in wild and domestic mammals. Methuen and Co. Ltd. London. 321 pp.

SHAFFER, M.L. 1978. Determining minimum viable population sizes: a case study of the grizzly bear (*Ursus arctos L.*). Ph.D. Thesis. Duke Univ., Durham, N. C. 192 pp.

_____. 1983. Determining minimum viable population sizes for the grizzly bear. Int. Conf. Bear Res. and Manage. 5:133-139.

STRINGHAM, S. F. 1980. Possible impacts of hunting on the grizzly/brown bear, a threatened species. Int. Conf. Bear Res. and Manage. 4:337-349.

_____. 1983. Roles of adult males in grizzly bear population ecology. Int. Conf. Bear Res. and Manage. 5:140-151.

_____. 1985. Responses by grizzly bear population dynamics to certain environmental and biosocial factors. Ph.D. Thesis, Univ. Tennessee, Knoxville. 454 pp.

_____. 1986*a*. Effects of climate, dump closure, and other factors on Yellowstone grizzly bear litter size. Int. Conf. Bear Res. and Manage. 6:33-39.

_____. 1986*b*. Bear demographics as functions of food supply per unit population biomass, body size, and other indices of nutritional status. Paper presented at the 7th Int. Conf. Bear Res. and Manage., Williamsburg, VA.

_____. 1988*a*. Litter sizes of Yellowstone grizzly bear relative to garbage supply, climate, and adult male abundance. J. Wildl. Manage. (submitted).

_____. 1988*b*. Bears: ecology, behavior, and population dynamics. Noyes Publications, Park Ridge, N.J. In press.

TAYLOR, M., T. LARSEN, and R. E. SCHWEINSBURG. 1985. Observations of intraspecific aggression and cannibalism in polar bears (*Ursus maritimus*). Arctic 38:303-309.

WALTERS, C. J., and R. HILBORN. 1978. Ecological optimization and adaptive management. Annu. Rev. Ecol. Syst. 9:157-188.

WATHEN, W. G. 1983. Reproduction and denning of black bears in the Great Smoky Mountains. M.S. Thesis, Univ. Tennessee, Knoxville. 134 pp.

WILSON, E. O. 1975. Sociobiology, the new synthesis. Belknap, Cambridge, Mass. 697 pp.

YOUNG, B. F., and R. L. RUFF. 1982. Population dynamics and movements of black bears in east central Alberta. J. Wildl. Manage. 46:845-860.

BLACK BEARS, PEOPLE, AND GARBAGE DUMPS IN MINNESOTA

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Editor's Note: This paper was not presented at the Symposium, but was submitted and published because of its relevance to the subject of the Symposium. It received the same peer review as other papers.

Abstract: Black bears (*Ursus americanus*) that fed at dumps continued to feed on wild foods. Feeding on garbage increased nutritional levels and enabled bears to grow more rapidly, mature sooner, and achieve higher reproductive success than did bears on solely natural diets. Use of dumps and competitive interactions increased in years when natural food was scarce. Properly situated garbage dumps may serve as buffers against nuisance activity rather than as an introduction to it. Injuries to people are rare at dumps. Dumps enable recreationists to become familiar with bear behaviour. Drawbacks of bears feeding in dumps are discussed.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Although open garbage pits are being phased out, hundreds remain, especially in black bear habitat. This paper reviews and summarizes information on the use of dumps by black bears and on bear-human interactions in northeastern Minnesota. The data were collected during ecological studies of black bears during 1969-1986 (Rogers 1987*a*).

STUDY AREA

The study area was centered in the Superior National Forest in northeastern Minnesota (Lat 47°45'N, Long 91°30'W). The area had low fertility and a growing season that averaged only 118 days between mid-May and mid-September (Rogers 1987*a*:8). Vegetation was typical of the northern Great Lakes region in that it contained components of both the boreal forest and the temperate deciduous forest (Maycock and Curtis 1960). Bear foods available in summer included hazelnuts (*Corylus cornuta*) and various fruits subject to frequent crop failure due to spring frost or summer drought (Rogers 1987*a*:9). The fruits most important to bears ripened in July, declined in late August, and became very scarce after that. Hard mast, other than unreliable hazelnuts, was absent over most of the area. Human presence included scattered resorts and residences and a community of approximately 35 families. South of the study area were larger communities of perhaps 40 - 200 families. Garbage pits varied from small pits used by single resorts or a few families to larger dumps used by the communities.

BEHAVIOUR, GROWTH, AND REPRODUCTION

Adult males predominated at community dumps, as was also reported by Black (1958) for New York. The sex ratio (M:F) of bears foot-snared at Minnesota dumps was 17:5, with 14 of the males being at least 3 years old. In the overall population, the sex ratio of bears at least 3 years old was 51:93 (Rogers 1987*a*:12).

Although both sexes used dumps within their usual ranges, only males concentrated their feeding at dumps when travelling outside their usual ranges. Females travelling outside their usual ranges avoided strange males (Jonkel and Cowan 1971; Garshelis and Pelton 1981), including aggregations of strange males at dumps (Rogers 1987*a*:34). Twenty-two (69%) of 32 radio-collared males travelled extensively outside their usual ranges in late summer and fall, with half of them concentrating their activities at dumps (Rogers 1987*a*:31, 34). Only 42 (40%) of 105 radio-collared females travelled extensively outside their usual ranges (male-female difference significant, $X^2 = 8.14$, 1 df, $P<0.005$) with none concentrating their activities at a dump (Rogers 1987*a*:31).

Bears that ate garbage also continued to forage for natural foods. Droppings at garbage dumps consisted mainly of wild foods until fruit disappeared in late August. During 1 - 23 August, 99 (75%) of 132 droppings collected at dumps contained mainly natural foods. During 24 - 31 August, the availability of wild fruit declined and only 26 (35%) of 74 droppings collected at dumps contained mainly natural foods. Few fruits were observed in the forest in September, and only 7 (8%) of 89 droppings collected at dumps during 1 - 10 September contained mainly wild food. Droppings collected at dumps after 10 September (*N*=14) contained only garbage. Thus, garbage supplemented wild food when wild food was available and provided nourishment after wild fruit and nuts became scarce, extending bears' growing season beyond that possible with only wild food.

Black bears that fed on garbage matured sooner and reproduced more successfully than bears that ate solely natural diets (Table 1).

Table 1. Reproductive parameters of female black bears eating natural foods only and supplemental garbage in northeastern Minnesota, 1970-1980[a].

Reproductive Parameter	Mean	Range	N
Natural Foods Only			
Age at first reproduction	6.3 years	4-8 years	17
Intervals between litters[b]	2.3 years	2-4 years	36
No. cubs in first litter	2.1 cubs	1-3 cubs	17
No. cubs in subsequent litters	2.5 cubs	1-3 cubs	35
With Supplemental Garbage			
Age at first reproduction	4.4 years	3-5 years	11
Intervals between litters[b]	2.0 years	2 years	8
No. cubs in first litter	2.5 cubs	1-3 cubs	8
No. cubs in subsequent litters	3.4 cubs	3-4 cubs	10

[a] Condensed from Rogers 1987*a*:Tables 8-10.

[b] Excluding intervals of 1 year due to litters being lost before mating seasons.

Bears that fed at dumps also grew more rapidly and became heavier (Rogers et al. 1976). A 3-year-old male weighed 177 kg, which is more than twice as heavy as any 3-year-old captured away from dumps in northeastern Minnesota. A 7-year-old male gained 104 kg in 71 days at a dump, gaining an average of nearly 1.5 kg/day. Black (1958) reported 3-week gains averaging 1.75 - 1.99 kg/day by adult males at dumps in New York. In the Minnesota study, the largest bears of each sex were captured at dumps, including a 278-kg male and a 135-kg female. The 278-kg male was very obese and abandoned the dump to retire to a den in late September, as was common for obese bears at dumps (Rogers 1987*a*:37). Matson (1946) reported that very obese bears in Pennsylvania abandoned abundant wild food to move to dens.

Black bears that forage on wild foods are typically active from dawn to 1 - 2 hours after sunset in summer (Garshelis and Pelton 1981; Rogers 1987*a*:18). Daylight feeding facilitates use of colour vision to find fruit (Bacon and Burghardt 1976; Garshelis and Pelton 1981). Bears that fed at dumps in Minnesota tended to follow a similar activity pattern, as determined during twenty-five 24-hour observation periods at 7 community dumps and additional observations at 21 other dumps. Bears typically gathered at most community dumps at dusk and moved away 1 - 3 hours later, presumably to sleep. However, activity patterns differed among individuals. A few bears visited dumps later at night or during the day. Activity patterns also differed between dumps. Bears visited Tofte dump mainly during the day and early evening. The major activity peak at Tofte dump in mid-August was between 0915 and 1330 hrs (maximum = 11 bears present at 1000 hrs, CST) with a shorter peak between 1730 and 1930 hrs (maximum = 12 bears at 1745 hrs). Fewest bears were present between 2145 and 0515 hrs (0-3). By contrast, bears visited the Babbitt dump mainly at night because workers there harassed bears during the day. This dump was covered daily with soil, so foraging took more time, and the bears dug throughout the night in mid-September, leaving around dawn. Peak activity was between 1900 and 0300 hrs (maximum = 8 bears present at 2245 hrs). Night feeding periods for 2 radio-collared males in this dump were 7.4 and 8.0 hours on 16 September. These were the smallest (91 kg) and largest (278 kg) bears observed in the dump. They spent the day 0.6 - 1.1 km away, mostly inactive.

Although territories of females overlapped little away from dumps, adjacent territories always overlapped at garbage dumps (Rogers 1987*a*:49). All dumps studied were located in narrow areas of territory overlap where territoriality gave way to dominance hierarchies (Rogers 1987*a*:49). Females whose territories did not border dumps seldom trespassed across territories to reach dumps, which corroborates findings by Jonkel and Cowan (1971) for Montana.

Despite the influence of dumps on local movements, the availability of dumps did not deter bears from making long foraging movements in late summer and early fall. Seven (30%) of 23 females with dumps in their territories left their territories temporarily to forage widely, as did 35 (31%) of 114 females with no dumps in their territories. Similarly, subadult males dispersed from their mothers' territories regardless of the presence of dumps, which suggests that the proximal stimulus for male dispersal is not food shortage (Rogers 1987*b*).

Food shortage influenced use of dumps in other ways, however. In years of natural food shortage, greater numbers of bears used dumps. Natural food was scarce in 1972, and the maximum number of bears seen in the Tofte dump at one time averaged 9.2 (range 7-12 bears) during five 24-hour periods. Natural food was more abundant in 1973, and the maximum number of bears seen at one time in that dump averaged only 5.8 (range 2-9) during ten 24-hour periods (difference significant, $t = 3.13$, 13 df, $P < 0.01$). Individuals also concentrated their foraging more strongly at dumps in years of natural food shortage (Rogers 1987*a*:34-36). As competition for garbage increased, serious fights became more common. Fights were common in 1985 when natural food was so scarce that nuisance complaints were at a record high (D. Garshelis 1986; Minnesota nuisance bear surveys -- 1981-1985; Minnesota Department of Natural Resources office memorandum). Injuries included a broken leg, a 12 cm laceration, and loss of a nose pad (Rogers 1987*a*:35). It was also in 1985 that the largest number of bears was observed feeding simultaneously in a dump -- 44 at the Colville dump near Grand Marais, Minnesota (Wm. Peterson, Minnesota Department of Natural Resources, pers. commun. 1985).

Despite the concentration of bears around the Colville dump, nuisance activity was curiously lacking within 10 km of the dump (Wm. Peterson, pers. commun. 1985). Similarly, nuisance activity in Kawishiwi River Campground was reduced below traditional levels during 1984-1987 when food was provided 0.43 km away (Rogers, unpubl. data). Further, a resort operator reported that he had few problems with bears during the years he maintained a dump 1 km from his resort, but that he has had numerous problems in the 10 years since the dump was closed (D. Bauer, pers. commun. 1986). These observations suggest that garbage dumps, properly situated, can serve as buffers against nuisance activity rather than as an introduction to it. The data suggest that bears tend to eat where they can most efficiently satisfy their nutritional needs. In years of abundant wild food, that will be in the forest. In other years, that may be in dumps or, in the absence of dumps, at campgrounds or residential areas.

In years of scarce wild food, black bears are almost as quick as chipmunks to overcome their fear of people and seek people's food. However, the notion that bears that taste unnatural food will preferentially seek it thereafter has little factual support, although this may be true for certain individuals due to individual taste preferences or injuries that hamper travel. Bears generally appear to prefer wild fruit and nuts, and they commonly abandon dumps and campgrounds when those wild foods are abundant. The notion that bears that taste human food will preferentially seek it thereafter is an unstated assumption underlying some management policies and should not be accepted without testing. Further study is needed to identify factors influencing nuisance behaviour, including the role of dumps.

BEAR-HUMAN INTERACTIONS AT DUMPS

Only nonhabituated bears that run when people appear are usually found at small dumps used by only a few people. Human smell on garbage apparently does little or nothing to habituate bears to human presence. However at large community dumps often frequented by people, bears become habituated to people, and many of these dumps in Minnesota have become tourist attractions. Most of the people watch the bears from their cars or from a distance, but a few mingle with them, throwing them food or even hand-feeding certain individuals. Some people test bears' responses by hitting them with rocks. Others come to dump garbage, typically paying little attention to the bears. The bears usually pay more attention to each other than to the people, although a few bears approach people for marshmallows or other treats not usually found in garbage.

Although people and bears have been mingling at dumps for decades, injuries to people are rare at dumps. No serious injuries at dumps have been reported in any of the northeastern states in which I have made extensive inquiry: Minnesota, Wisconsin, Michigan, New York, Vermont, New Hampshire, and Maine. However, numerous injuries have been associated with hand-feeding of bears in national parks (Pelton et al. 1976; Singer and Bratton 1980). The difference in numbers of injuries is probably due to differences in the 2 situations. Bears visit dumps primarily to eat garbage, not to seek handouts from people. They tend to be so well fed that the few that do seek handouts are hard to tease with food. The vast majority ignore or avoid observers that keep a respectful distance, and the garbage that often surrounds feeding bears discourages many people from approaching.

Black bears that are approached at dumps retreat rather than defend their food. All feeding bears, including groups, observed by the author during 21 years of study retreated when approached closely. Being solitary animals, they apparently form no social alliances other than family groups (Rogers 1987*a*:50) and feel no safety in numbers.

Dumps provide opportunities for people to see the largest and most dominant bears in the population (Rogers 1987*a*:35). Viewing bears at dumps may be the only regular opportunity for most people to see interactions among bears, including play. Bears that are less well fed seldom play, spending nearly all their waking hours foraging (Egbert and Stokes 1976; Rogers 1987*a*:49). Dumps give recreationists the chance to become familiar with black bear vocalizations and body language. This may help them overcome apprehension about camping and hiking in black bear country, and provide them with knowledge of bear behaviour and communication that may be helpful when responding to encounters with bears.

HEALTH AND MORTALITY FACTORS

Dumps may be sources of parasites such as trichina worms (*Trichinella spiralis*) and fish tapeworms (*Diphyllobothrium* spp.). However, garbage is probably not the usual source of trichina worms because bear trichinosis is less common where garbage is abundant than it is in remote regions of Canada and Alaska (Rogers and Rogers 1976).

Dumps can contain toxic substances which bears could carry off or consume. Bears commonly carry plastic bags into the woods and scatter the contents while searching for edible garbage. This problem can be reduced by people emptying plastic bags into dumps rather than throwing them in full. There have been no reports of bears dying as a result of poisoning at dumps.

Stringham (In Press) presented evidence that mortality among grizzly bear (*Ursus arctos*) cubs is higher where grizzlies congregate than in other areas. He attributed the difference to cannibalism. Black bear cubs may be less vulnerable to this because they more readily climb trees and they are commonly left up trees while their mothers feed at dumps.

Bears that feed in dumps can be especially vulnerable to hunters because hunters often concentrate at dumps (Rogers, unpubl. data). To reduce this problem and to increase safety for people at dumps, shooting is illegal within 0.8 km (0.5 mi) of dumps in Minnesota.

LITERATURE CITED

BACON, E. S., and G. M. BURGHARDT. 1976. Learning and color discrimination in the American black bear. Int. Conf. Bear Res. and Manage. 3:27-36.

BLACK, H. C. 1958. Black bear research in New York. Trans. N. Am. Wildl. Conf. 23:443-461.

EGBERT, A. L., and A. W. STOKES. 1976. The social behavior of brown bears on an Alaskan salmon stream. Int. Conf. Bear Res. and Manage. 3:41-56.

GARSHELIS, D. L., and M. R. PELTON. 1981. Movements of black bears in the Great Smoky Mountains National Park. J. Wildl. Manage. 45:912-925.

JONKEL, C., and I. McT. COWAN. 1971. The black bear in the spruce-fir forest. Wildl. Monogr. 27. 57 pp.

MATSON, J. R. 1946. Notes on dormancy in the black bear. J. Mammal. 27:203-212.

MAYCOCK, A.C., and J. T. CURTIS. 1960. The phytosociology of boreal conifer-hardwood forests of the Great Lakes Region. Ecol. Monogr. 30:1-35.

PELTON, M. R., C. D. SCOTT, and G. M. BURGHARDT. 1976. Attitudes and opinions of persons experiencing property damage and/or injury by black bears in the Great Smoky Mountains National Park. Int. Conf. Bear Res. and Manage. 3:157-167.

ROGERS, L. L. 1987*a*. Effects of food supply and kinship on social behavior, movements, and population growth of black bears in northeastern Minnesota. Wildl. Monogr. 97. 72 pp.

_____. 1987*b*. Factors in dispersal of black bears. Pages 75-84 *in* B. D. Chepko-Sade and Z. T. Halpin, eds. Mammalian dispersal patterns: the effects of social structure on population genetics. University of Chicago Press. Chicago.

_____, D. W. KUEHN, A. W. ERICKSON, E. M. HARGER, L. J. VERME, and J. J. OZOGA. 1976. Characteristics and management of black bears that feed in garbage dumps, campgrounds, or residential areas. Int. Conf. Bear Res. and Manage. 3:169-175.

_____, and S. M. ROGERS. 1976. Parasites of bears: a review. Int. Conf. Bear Res. and Manage. 3:411-430.

SINGER, F. J. , and S. P. BRATTON. 1980. Black bear/human conflicts in the Great Smoky Mountains National Park. Int. Conf. Bear Res. and Manage. 4:137-139.

STRINGHAM, S. F. 1988. Bears: ecology, behavior, and population dynamics. Noyes Publications, Park Ridge, N.J. In press.

ECOLOGICAL AND BEHAVIOURAL RESPONSES OF BLACK BEARS IN NATIONAL PARKS OF THE SIERRA NEVADA, CALIFORNIA, TO ANTHROPOGENIC FOODS, AND TO MANAGEMENT STRATEGIES DESIGNED TO REDUCE CONFLICTS

(Abstract Only)

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Abstract: For more than 10 years, it has been recognized that human visitation and the resultant plentiful supply of nutritious, concentrated anthropogenic food have resulted in significant alterations of the behaviour and ecology of black bears (*Ursus americanus*) in the national parks of the Sierra Nevada, California. These changes contradict the National Park Service's mission of maintaining naturally functioning ecosystems and their elements, and also aggravate conflicts between bears and visitors. Black bears in the Sierra Nevada with access to anthropogenic food grow larger, reach sexual maturity earlier, and have a higher reproductive rate than control bears. Where food must be acquired directly from people and their camps, these bears evidence both diminished fear of humans, and alterations in activity schedules designed to reduce conflicts. Traditional management practices have resulted in recruitment compensation, and some indication of alterations in social structure. More recent techniques for diminishing bear-human conflicts have concentrated on directly reducing the availability of anthropogenic food.

SECTION II. BEAR DETECTION AND DETERRENT TECHNIQUES

CHAIRMAN: L. RONALD QUAIFE, Esso Resources Canada Ltd., Calgary, Alberta

LIVESTOCK-GUARDING DOGS REDUCE DEPREDATION BY BEARS

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Abstract: Data gathered in the livestock-guarding dog project of the U.S. Department of Agriculture, Agricultural Research Service were reviewed and information was compiled that related to guarding dog-bear (*Ursus* spp.) encounters. Three Eurasian breeds of dog (Komondor, Great Pyrenees, and Akbash Dog) were studied. Seventy-five percent of 20 encounters between livestock-guarding dogs and black bears (*Ursus americanus*) (17 encounters) and grizzly bears (*Ursus arctos*) (3 encounters) resulted in either bears being chased off without preying on sheep, or in bears being shot by shepherds. Grizzly bears appeared to be less easily deterred than black bears. Most encounters occurred during evening as dogs accompanied rangeland bands of sheep on semi-forested summer range. In general, dogs reacted toward bears with barking and a running approach. Livestock-guarding dogs reduce bear depredation on sheep, thereby reducing human-bear conflicts.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Black bears and occasionally grizzly bears cause damage to livestock and other agriculture in various parts of North America. Reports from the Animal Damage Control (ADC) program of the U.S. Fish and Wildlife Service for fiscal year 1982 (October 1981 - September 1982) show a loss to bears of $124,003 for 8 western states (Arizona, California, Colorado, Idaho, Montana, Oregon, Utah, and Wyoming). Most of the damage was to sheep ($80,000), apiaries ($23,115), and cattle ($10,831) (U.S. Fish and Wildlife Service, unpubl. annu. rep., Washington, D.C.). Losses tabulated by ADC may be considerably less than actual losses because some incidents of predation are not reported by producers. For example, ADC reported that bear damage to sheep in Idaho during fiscal year 1986 (October 1985 - September 1986) totalled $20,521, while the Idaho Wool Growers Association reported a loss to bears during calendar year 1986 of $195,000 (Idaho Wool Growers Association 1986).

Most efforts to reduce predation of livestock in the United States are directed at coyotes (*Canis latrans*), the principal predators of sheep and goats, especially in the western states. Livestock-guarding dogs, first studied in the United States in 1977 as a method of reducing coyote predation, are being used in increasing numbers for that purpose throughout North America. The dogs, mostly of Eurasian origin, have proven to be effective in preventing coyote depredation under a variety of grazing conditions (Linhart et al. 1979; McGrew and Blakesly 1982; Coppinger et al. 1983; Green and Woodruff 1983*a*, *b*,*c*).

The effectiveness of guarding dogs in reducing livestock predation by bears in North America and Eurasia, where bears are also a common predator, has not been discussed in the literature. The widespread public interest in predator control (Arthur et al. 1977) emphasizes the importance of reporting new control techniques. We investigated reports of encounters between livestock-guarding dogs and bears to determine the effectiveness of dogs in reducing predation by bears.

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We thank the livestock producers and herders who worked with the guarding dogs and provided information for this report.

METHODS

Research on livestock-guarding dogs has been conducted since 1977 by the U.S. Department of Agriculture, Agriculture Research Service at the U.S. Sheep Experiment Station (USSES) in southeastern Idaho. Three Eurasian breeds of dog were studied: Komondors of Hungary, Great Pyrenees of France and Spain, and Akbash Dogs of Turkey. Details of the dog rearing and socialization process were reported previously (Green and Woodruff 1983*a,b*). Briefly, the majority of dogs were purchased from commercial kennels at about 8 weeks of age and reared with lambs at the USSES. Some dogs were evaluated at the USSES while others were used and evaluated by private sheep producers. Data collected during the dog study (1977-1986) were reviewed and information was compiled that related to dog-bear encounters. In addition to data from USSES dogs, data from other livestock producers who had used guarding dogs were reviewed. These data were acquired in questionnaire surveys (Green et al. 1984; Green and Woodruff 1988).

In some instances, producers were telephoned and asked to provide additional data concerning the encounter.

RESULTS AND DISCUSSION

Rarely do people observe encounters between guarding dogs and predators. Most predators avoid humans and human activity, and predation often occurs during crepuscular or nighttime hours. As a result, the guarding dog is heard barking, but neither the object of the barking nor the encounter is seen.

USSES Dogs

Twelve guarding dogs from the USSES (8 Great Pyrenees, 4 Akbash Dogs) were observed in encounters with bears. Seven dogs had more than 1 observed encounter. At least 3 of the dogs were heard during the night in several additional encounters, which evidence (i.e., hearing bear growls, finding bear tracks and scat) indicated were with bears. Three dogs were involved with grizzly bears, and the remainder with black bears (Table 1). Additional details of the encounters are in Appendix 1.

All of the encounters occurred during summer (July - September) while dogs were with range bands of sheep on mountain summer range (elevation 2,000 - 3,000 m). The habitats consisted of grass-forb meadows interspersed with sparse-to-dense stands of timber. A range band can contain any number of sheep, but on western ranges a typical band would include approximately 1,000 ewes and 1,400 lambs (Gee and Magleby 1976).

Dogs Of Other Producers

We received information from 5 livestock producers concerning their dog(s) and bears (Table 1). A producer from British Columbia observed 3 encounters involving 12 goats, 1 or 2 Akbash Dogs, and black bears. In each encounter the dog(s) aggressively confronted the bear(s), and in 2 instances the bears were treed.

A producer from Minnesota reported an encounter between a black bear and a Kuvasz dog (Hungarian breed) guarding 80 ewes. The bear injured 1 sheep and the dog, which lost all 4 upper and 2 lower incisors during the incident. Although the producer did not personally observe the nighttime encounter, professional trappers visited the scene the next morning and confirmed that a bear had been involved.

A second incident in which dogs were injured occurred in Montana as 2 Great Pyrenees were guarding a range band of sheep. The shepherd heard an encounter during the night. The next morning no sheep were found injured, but both dogs had minor "slash wounds", bear sign was found, and a black bear was observed near the sheep watering area some distance away.

A producer from California reported that her Akbash Dog chased a black bear away from her apiary, and that the bear did not return. The producer stated that prior to getting the dog the only way to stop recurrent bear raids on the apiary was to move it to a different location.

A sheep producer from Montana observed her 2 Great Pyrenees chase a black bear from the sheep one evening when the sheep were corralled near a barn.

Table 1. Encounters between livestock-guarding dogs and black or grizzly bears.[a]

	Dog			Species		
	Breed	Sex	Age (years)	of Bear	Livestock	Bear Predation
1.	Pyr	M	2	Black	Sheep band	None
2.	Pyr	M	1	Black	Sheep band	1 ewe
3.	Pyr	M	1	Black	Sheep band	None
	Akb	F	1			
4.	Akb	M	2	Black	Sheep band	1 sheep
	Akb	F	2			
5.	Akb	M	1	Black	Sheep band	4 sheep/ 2-week period
	Pyr	F	2			
6.	Pyr	F	1	Black	Sheep band	1 ewe
7.	Pyr	M	2.5	Black	Sheep band	none
8.	Akb	F	3	Grizzly	Sheep band	none
9.	Akb	F	4	Grizzly	Sheep band	none
10.	Pyr	F	1.5	Black	Sheep band	none
11.	Pyr	M	2.5	Grizzly	Sheep band	27 sheep
12.	Pyr	M	5.5	Black	Sheep band	none
13.	Akb	M	4.5	Black	Sheep band	none
	Pyr	F	2.5			
14.	Akb	F	unknown	Black	Goats	none
15.	Kuv	M	1.5	Black	Sheep flock	none
16.	Pyr	F	4	Black	Sheep band	none
	Pyr	F	2			
17.	Akb	M	0.5	Black	Goat flock	none
18.	Akb	M	1.5	Black	Goat flock	none
	Akb	F	1			

[a] Incidents 1-13 are with U.S. Sheep Station dogs. Pyr = Great Pyrenees, Akb = Akbash Dog, Kuv = Kuvasz.

Characteristics of Guarding Dog-Black Bear Encounters

Many of the encounters between a guarding dog protecting sheep and a black bear were similar. Most encounters occurred in the evening when black bears are more active (Amstrup and Beecham 1976). In a typical encounter, after sensing the presence of a black bear, the dog would bark repeatedly and approach to confront the bear. The bear would normally respond by retreating from the dog as soon as it became aware of the dog's approach. There was usually no physical contact between the dog and bear, and the dog would continue pursuit for several hundred metres or until the bear was heading away from the sheep. The dog would typically return to the sheep soon after the encounter.

A similar relationship between bears and livestock-guarding dogs has been noted elsewhere. In his book on Maremmas (Italian livestock-guarding dog), Breber (1978:87,89; translated by J. Catano) wrote the following concerning dog-bear encounters:

> The dogs confronted [a bear]...with much different tactics than those used against wolves. The dogs can't pretend to be able to overcome him or even scare him, so they try to drive him from the flock by pestering. When they discover a bear, they quickly surround him and, barking loudly, maintain their distance. The dogs then snap at him from all directions with great quickness, avoiding his lightning-quick paws. Intimidated in this way, the bear loses its appetite for sheep and he heads for the woods, in the direction of which the dogs have gradually pushed him.

In 3 encounters bears climbed trees. One involved a single adult bear, and the others each involved 2 cubs. A sow is normally reluctant to leave an area without her cubs. In both instances with cubs, the dogs were called off, and the cubs were gone the next morning.

It appears that many dog-bear encounters are accidental and result simply from sheep being in a bear's home range. The presence of a bear near sheep is rarely sufficient evidence to indicate the bear is predatory. Data in this report indicated that most dog-bear encounters are brief and that most black bears can be easily chased away by guarding dogs. These observations agree with conclusions reached by Jorgensen (1979) following a study of bear-livestock interactions. Of 7 black bears that were radio-monitored, 2 showed interest in, 2 exhibited aversion to, and 2 were neutral in behaviour toward bands of sheep within their home ranges. Only 1 bear was a verified sheep killer. In general, the presence of sheep did not necessarily affect the activities of bears.

Guarding Dog-Grizzly Bear Encounters

At least 3 USSES dogs had encounters with grizzly bears; however sufficient information is available on only 2 incidents. A female Akbash Dog guarding a range band of sheep in Montana has had several encounters with black bears and with grizzly bears. On a moonlit night the owner watched an encounter with a lone grizzly bear that lasted approximately 3 hours. Bouts between the dog and the bear were similar to the "typical" dog-black bear encounter described previously; however, in this instance the bear repeatedly returned to the band and was more difficult to repel than a black bear. The dog would stand nose-to-nose with the bear, and if the bear made an offensive move toward the dog, the dog deftly avoided the bear's attack, quickly circled, and lunged at the exposed flank of the bear. After a series of these bouts that gradually moved the bear away from the sheep, the bear would amble off, and the dog would return to the flock. This series of events occurred several times during the 3-hour period. No sheep were lost during the encounter.

In another incident, a male Great Pyrenees was guarding a range band of sheep in Idaho. A grizzly bear attacked the flock 6 nights during a 7-day period. In each instance the shepherd heard the dog barking but was fearful of investigating. From 1 to 7 sheep were killed in each attack, and 27 in total were killed during the 7-day incident. Although the dog successfully repelled black bears on several occasions, it was not effective in repelling this grizzly.

Although our sample is small, evidence provided by 2 experienced sheep producers familiar with bear predation suggests that grizzly bears are less readily deterred by guarding dogs than are black bears. Where grizzly bears are a potential predator, 2 dogs may be preferred.

Effectiveness of Dogs In Preventing Bear Depredation

Bear depredation on sheep is not uncommon when sheep are grazed in bear habitat, but the frequency of bear attacks is highly variable and unpredictable. Generally, sheep producers consider bear depredation to be secondary to coyote depredation in terms of number of animals killed. However, the potential exists for a bear to kill a large number of sheep in a single attack.

Predation by bears was associated with 25% of the encounters reported in this paper. With the exception of the grizzly bear that killed 27 sheep over a 7-day period, losses to bears were generally not severe.

Other data on bear predation for several range bands are available. Bands at the USSES usually suffer losses to black bears each summer, and bands have 1 or 2 guarding dogs with them. In 1986, a band with a yearling Akbash Dog lost 18 sheep to black bears over approximately a 60-day period. With the exception of 1 night when 2 sheep were killed, only 1 kill was made per incident. Several of the kills were made by a sow with 2 cubs. The dog was well-bonded to the sheep and barked at predators during the night. The herder speculated that losses to bears would have been higher without the dog.

A second USSES band lost 8 sheep in 7 incidents during the same period. Several of the kills were made by a sow with 2 cubs. The band had 2 guarding dogs with it. A third band, also with 2 guarding dogs, had no losses to bears during the period although bears were observed in the area. Losses to bears in previous years averaged 2 per band, and each band has had 1 or 2 guarding dogs present for the past 6 years. With the exception of rare attacks by a grizzly bear, the herders felt that guarding dogs helped minimize sheep losses to black bears.

One producer reported losses in 1 band to black bears of 8, 11, and 1 sheep during 3 successive summer grazing periods. A guarding dog was placed with the band, and over the next 4 summers losses to bears were 5, 0, 27 (to 1 grizzly bear), and 0. The producer felt his dog was reasonably effective in deterring black bears but was unable to dissuade a persistent predatory grizzly bear.

Many sheep producers who have used guarding dogs expressed confidence in them as a worthwhile method of predation control (Green and Woodruff 1988).

A Controlled Test of Guarding Dog Effectiveness

During summer 1985 in Minnesota, a test was conducted to determine the effectiveness of a guarding dog in keeping wolves (*C. lupus*) and black bears from carrion feeding sites (L. Coppinger, pers. commun.). Two bait stations were established approximately 0.8 km apart and were checked periodically for feeding activity by wolves and bears. Once animals were routinely feeding at the sites, a guarding dog that had been trained to remain within a prescribed area was stationed at 1 site. The dog remained at the site for 1 week during which time wolves and bears stopped feeding there. Wolves and bears continued to visit and feed at the other site. Further tests of a similar nature are planned.

SUMMARY AND CONCLUSIONS

Livestock-guarding dogs are capable of preventing or reducing depredation by bears on sheep and potentially other livestock. Dogs react to bears with barking and a running approach, and most bears respond by retreating and avoiding a physical confrontation. Black bears are probably more easily repelled by dogs than are grizzly bears. The use of guarding dogs in other situations (e.g., protecting orchard, apiaries, back-country homesteads) appears to be worthy of consideration.

LITERATURE CITED

AMSTRUP, S. C., and J. BEECHAM. 1976. Activity patterns of radio-collared black bears in Idaho. J. Wild. Manage. 40:34-348.

ARTHUR, L. M., R. L. GUM, E. H. CARPENTER, and W. W. SHAW. 1977. Predator control: the public viewpoint. Trans. North Am. Wildl. and Nat. Resour. Conf. 42:137-145.

BREBER, P. 1978. Il cane de pastore maremmano-abruzzese. Editoriale Olimpia, Italy. 173 pp.

COPPINGER, R., J. LORENZ, and L. COPPINGER. 1983. Introducing livestock guarding dogs to sheep and goat producers. Pages 129-132 *in* D. J. Decker, ed. Proc. first eastern wildl. damage control conf., Cornell Univ., Ithaca, N.Y.

GEE, C.K., and R. S. MAGLEBY. 1976. Characteristics of sheep production in the western United States. U.S. Dept. Agric., Agric. Econ. Rep. 345. 47 pp.

GREEN, J. S., and R. A. WOODRUFF. 1983*a*. Guarding dogs protect sheep from predators. U.S. Dept. Agric., Agric. Info. Bull. 455. 27 pp.

_____, and _____. 1983*b*. The use of Eurasian dogs to protect sheep from predators in North America: a summary of research at the U.S. Sheep Experiment Station. Pages 119-124 *in* D. J. Decker, ed. Proc. first eastern wildl. damage control conf., Cornell Univ., Ithaca, N.Y.

_____, and _____. 1983*c*. The use of three breeds of dogs to protect rangeland sheep from predators. Appl. An. Ethol. 11:141-161.

_____, and _____. 1988. Breed comparison and characteristics of use of livestock guarding dogs. J. Range Manage. 41:249-251.

_____, _____, and T. T. TUELLER. 1984. Livestock guarding dogs for predator control: costs, benefits, and practicality. Wildl. Soc. Bull. 12:44-50.

IDAHO WOOL GROWERS ASSOCIATION. 1986. In 1985, the Idaho sheep industry suffered a $4,87 million death and theft loss. Idaho Wood Growers Bull. 67:4.

JORGENSEN, C. 1979. Bear-livestock interactions, Targhee National Forest. M.S. Thesis, Univ. Montana, Missoula. 162 pp.

LINHART, S. B., R. T. STERNER, T. C. CARRIGAN, and D. R. HENNE. 1979. Komondor guard dogs reduce sheep losses to coyotes: a preliminary evaluation. J. Range Manage. 32:238-241.

McGREW, J. C., and C. S. BLAKESLY. 1982. How Komondor dogs reduce sheep losses to coyotes. J. Range Manage. 35:693-696.

Appendix 1. Supplementary notes for encounters between livestock-guarding dogs and black or grizzly bears. (Numbered incidents correspond to those in Table 1).

1. Dog saw bear come out from timber near sheep; chased bear off.
2. Dog found bear eating ewe; dog barked, chased,and treed bear; herder responded to dog barking and shot bear.
3. Female dog confronted bear near sheep and held bear at bay; male dog stood nearby; herder responded to dog's bark and shot bear.
4. Herder on horseback came upon bear and was thrown from horse; male dog ran bear off; female remained with sheep.
5. Dogs barked several nights at unobserved predators; bear killed 4 sheep; 1 morning dogs came from timber toward sheep; bear emerged shortly thereafter; herder shot bear.
6. Dog saw sow and 2 cubs near sheep at 1700 hours and barked-chased; sow ran off and cubs treed; cubs gone by next morning.
7. Dog scented something and ran into brushy area near sheep; dog flushed 2 bears and gave chase.
8. Bear approached band; dog confronted bear and ran behind until bear left the area.
9. Same dog as account 8; dog repeatedly confronted bear during moonlit night; bear was repelled but came back several times during a 3-hour period before it finally left.
10. Dog observed bear near band and gave chase; dog returned several hours later.
11. Bear attacked band on 6 of 7 nights; dog confronted bear each time but was not able to drive it away.
12. Two similar encounters; in each the dog sighted bear near sheep and gave chase until bear was run off.
13. Both dogs observed bear near sheep and gave chase until bear ran from area.
14. Dog chased bear from apiary.
15. Producer heard dog bark during night; next day dog and 1 sheep injured; bear sign observed.
16. Herder heard dogs bark at night, next day both dogs had "slash marks"; bear observed nearby.
17. Dog chased sow and 2 cubs; cubs treed and sow faced dog; owner called dog off, sow called cubs down and ran off.
18. Same male as account 17; 2 encounters: 1) Female dog trailed bear and confronted it; male dog heard barks and joined female; bear treed and dogs were called off; 2) Both dogs scented bear and tracked it; bear and dogs faced-off; owner arrived and bear ran away.

THE TWELVE GAUGE SHOTGUN: A BEAR DETERRENT AND PROTECTION WEAPON

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Abstract: Bear-people conflicts may occur at any time of the year in the Northwest Territories. Problem bears are associated with recreational camps and activities, industrial development, communities, and outpost camps. In many cases conflicts with bears take place in remote areas and people on site must react to the problems. To manage bear conflicts it is essential that people at these sites have an effective, practical and ready available deterrent and protection weapon. The twelve gauge pump action shotgun is the recommended weapon for deterring and, if necessary, destroying bears. By using a 3-slug system (cracker shells, plastic slugs, lead slugs) it is possible to deter a bear from a site and still be prepared to destroy it if necessary. Anyone using the twelve gauge shotgun for deterring or destroying bears should receive proper training in the use of firearms. The twelve gauge shotgun and the 3-slug system allow more options for people handling bear problems, and should reduce the number of bears that need to be destroyed in problem situations. Deterring bears from sites inhabited by people will begin to teach bears to avoid close contact with people and promote a bear population that is involved in fewer conflicts.

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Throughout the Northwest Territories bears inhabit most of their historical ranges: polar bears (*Ursus maritimus*) along the arctic coast and arctic islands (Urquhart and Schweinsburg 1984); brown (grizzly) bears (*U. arctos*) in the Mackenzie Mountains and barren lands (Miller et al. 1982, Nagy et al. 1983); and black bears (*U. americanus*) below the treeline (Clarkson 1988). As more people venture into bear habitat the potential for problems increases. Problems with black and grizzly bears can occur in the spring, summer, and fall, while conflicts with polar bears are possible throughout the year. Past bear-people conflicts in the North have involved industrial sites, recreational activities, communities, and outpost camps (Stirling 1975; Stenhouse 1982, 1983; Bromley 1985). Most problems result in property damage and the destruction of the bear and a few conflicts have resulted in human injury or death. Many bear problems could be avoided if people were better informed and exercised appropriate precautions.

Although some situations can be handled by Renewable Resource Officers, most areas are too remote to rely on their assistance. Consequently, local people need to know how to prevent and effectively handle bear problems. This paper discusses the use of a twelve gauge shotgun and 3-slug system for handling bear problems.

The plastic slug deterrent research by past resource people is appreciated. Their ideas, testing, and analysis have contributed to the development of the plastic slug. The plastic slug research and development of AAI Corporation and Mountain Scent Research have also contributed to the testing program. A special thanks to the companies and government agencies that have provided logistical and financial support during testing. Thanks to S. Mayberry and D. Blake for carefully typing and D. Mould for drawing all figures in the paper.

THE TWELVE GAUGE SHOTGUN

The twelve gauge pump action shotgun is recommended for handling bear problems because it can be used to deter and, if necessary, destroy a problem bear. Many people are familiar with the shotgun and it is often used for protection against bears. It is easy to use and little practice is required to become familiar with it. It is not a restricted weapon and can be purchased in most sporting goods or hardware stores.

In order to take advantage of the full range of deterrent and protection options, a shotgun with several special features is recommended (Figure 1). A pump action is best for fast manual loading of shells into the chamber. Single-shot shotguns do not allow for quick reloading in conflict situations. The semi-automatic action is not recommended because its loading section is not activated by low powder loads of cracker shells and plastic slugs and it is subject to jamming. The magazine plug should be removed to accommodate more shells. Without the magazine plug a regular pump action shotgun will take 4 shells and one with an extended magazine will hold 7 shells. A long slit cut in the magazine loading cover assists in dejamming in the pump action shotgun. If a shell is caught in the loading mechanism it can be reached through the slit and pushed forward. Rifle sights should be placed on the shotgun to increase shooting accuracy. The shotgun should be fitted with a sling for easier carrying. Tape or

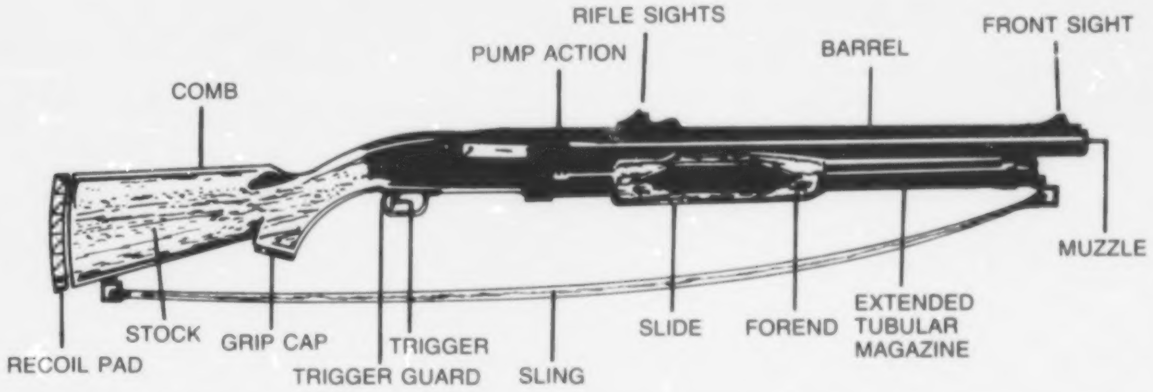

Figure 1. The twelve gauge pump action shotgun.

a balloon can be put over the end of the barrel to keep it clear of snow or dirt.

If the gun is going to be used in cold weather (below -10°C), the firing and loading mechanisms should be degreased to prevent freeze-up and misfiring. A graphite powder can be applied once the gun is degreased. A stainless steel shotgun is recommended for wet environments to avoid rusting and associated problems with the loading and firing mechanisms. Taking the time to properly maintain a shotgun will help ensure it is always in good working condition.

DETERRING BEARS

Deterring problem bears is a fairly recent management strategy. When a bear is deterred, it is given another chance to avoid areas of human activity. Some bears can be quickly conditioned to avoid such areas if their deterrent experience is negative. The bears soon begin to associate people with an unpleasant or painful experience. Timing is important when using deterrents. The deterrent attempt is more likely to be successful if a bear can be deterred the first time it approaches a camp, before it has had a chance to receive a food reward. Bears that have previously received a food reward may be more difficult to deter, but can be deterred and conditioned to avoid certain areas. The twelve gauge shotgun works well for deterring bears because it can be used to shoot cracker shells and plastic slugs.

Cracker Shells

Cracker shells successfully deterred some bears during testing at Cape Churchill (Stenhouse 1983, Stenhouse and Cattet 1984). The cracker shell used in 1982 and 1983 was manufactured by Pairs Wessex Ltd., London, England and is not recommended for use in shotguns. Other twelve gauge cracker shells were used at Cape Churchill to deter bears in 1986 and 1987 but were not recorded as formal deterrent testing. Cracker shells have been used successfully to deter bears in the town of Churchill, Manitoba; at the Fort Prince of Wales, Manitoba historical site (Leonard 1989); and in developed areas of Denali National Park, Alaska (Dalle-Molle and Van Horne 1989).

Cracker shells work best when the bear is first approaching a site (Figure 2). At a distance of 150-200 m a cracker shell can be fired at the bear and land between the bear and the person firing the shell. Test-fire practice rounds to determine what distance the cracker shells will reach before exploding. When using a cracker shell the shooter should ensure that the barrel of the shotgun is free from obstructions before the next shot is fired. In forested areas cracker shells may start fires if the shell contacts the ground before or when it explodes. If the bear approaches closer than 120 m the shell could explode behind the bear and scare the bear towards the shooter.

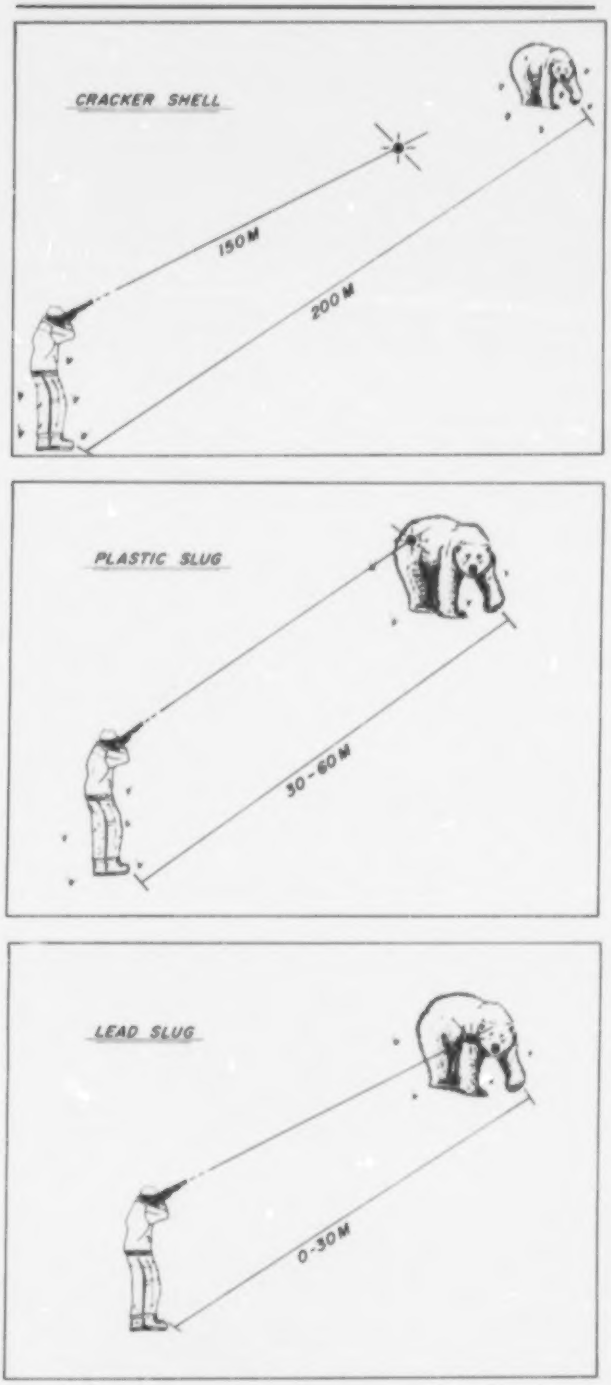

Figure 2. Deterring and destroying a bear with a twelve gauge shotgun.

Cracker shells are usually sold in boxes of 5 or 20 at an approximate cost of $1.25 per shell. The shells are available through most safety supply and wildlife control dealers. Care should be taken to follow all of the manufacturer's recommendations for safe use of cracker shells.

Not all bears will be deterred by cracker shells (Stenhouse 1983, Stenhouse and Cattet 1984). Some bears that are initially deterred may in subsequent deterrent attempts become habituated to the noise because it does not hurt them. If a bear is not deterred by a cracker shell and proceeds to approach a site, it can then be hit with a plastic slug.

Plastic Slugs

Twelve gauge plastic slugs were developed for bear deterrent work to provide the bear with an unpleasant or painful experience without causing penetration of the hide or other injury. The plastic slug is a torpedo-shaped projectile made from a polyurethane plastic (Figure 3). The torpedo shape and fins help keep the slug's trajectory accurate.. Because the projectile is 50 mm long, a special wad (gas check) was designed. For an effective range of 30 to 60 m, 8 grains of red dot powder are used. Other fast-burning powders may also work well. The hull is a normal shotgun shell hull with a Federal 209 (or similar) shot shell primer. The case is given a roll crimp to hold the projectile in the hull.

Initial research into the plastic slug involved transferring a similar technology used by police for enforcement work. For the plastic slug to be effective as a bear deterrent, it had to cause some pain, but not penetrate the hide or break bones. This created some problems, as a slug that was an effective deterrent at 40 m might easily penetrate bear hide at 10 m. The size of the twelve gauge slug prevented development of a slug that was effective at all distances. To solve this problem researchers looked at the distances at which bears would need to be deterred and at which they could be safely

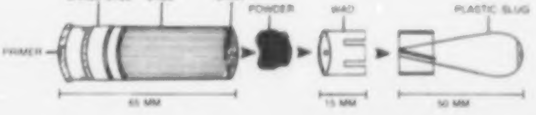

Figure 3. Components of the plastic slug.

Table 1. Testing of twelve gauge plastic slugs on bears.

Date	Researcher(s)	Slug Name/ Manufacturer	Impact Energy[a] joules (FPE)[b]	Deterrent Attempts/ Successful
1982	Stenhouse[c]	Ferrett/AAI[d]	104.7 (77)	25/0
1983	Stenhouse[e] & Cattet	Ferrett/AAI	104.7 (77)	49/27
1984	Derocher[f] & Miller	Ferrett/AAI	95 (70)	136/107[g]
1984-1986	Dalle-Molle[h] & Van Horn	55200/AAI	N/A	5/5[i]
1984	Wooldridge[j]	55200/AAI	N/A	23/23
1985	Clarkson[k]	Ferrett/AAI	101.7 (75)	46/46
1986	Clarkson[l]	Stinger/MSR[m]	101.7 (75)	11/11

[a] Input energy at 40-50 m.
[b] Foot-Pounds Energy.
[c] Stenhouse 1983.
[d] AAI Corporation, Baltimore, Maryland.
[e] Stenhouse and Cattet 1984.
[f] Derocher and Miller 1986.
[g] 69 of the 107 bears were deterred off the bait but returned during the trial.
[h] Dalle-Molle and Van Horn 1989.
[i] These bears were radio-collared and tested over 3 summers, 1984-1986.
[j] Wooldridge 1984.
[k] Clarkson 1987.
[l] Clarkson (In prep.).
[m] Mountain Scent Research, Stevensville, Montana.

deterred. Thirty to 60 m was considered appropriate for most deterrent situations.

With a particular distance to work from, it was then possible to begin developing an effective slug. There were several early generations of the plastic slugs (Table 1). The first deterrent testing was conducted on polar bears at Churchill (Stenhouse 1983). During the first few years of testing several problems were encountered: slugs had too much impact energy, not enough impact energy, were not accurate, and were expensive to produce. By continuing research and development, it was possible to develop a plastic slug that was effective in deterring polar bears (Clarkson 1987).

Research on plastic slugs is still being conducted as Renewable Resource Officers throughout the Northwest Territories are testing the slugs in real situations with problem bears. The Yukon Fish and Wildlife Department, Kluane National Park (Yukon), and Denali National Park (Alaska) are also testing the slug on problem bears.

There are presently 2 companies producing the plastic slugs: AAI Corporation, Baltimore, Maryland and Mountain Scent Research, Stevensville, Montana. At this time there are no retail dealers for the plastic slugs. Cost of the slugs from the producers will vary depending on the number of slugs purchased and on whether they are sold assembled or as components.

A plastic slug can be fired at the bear when it is within 30-60 m (Figure 2). One to several shots may be required to deter a bear. Plastic slugs should be aimed at the large muscle mass areas (rump, shoulder, upper neck) for deterring a bear (Figure 4). The actual location of the hit will depend on the surrounding terrain, distance, and approach of the bear. A bear's head should not be hit with a plastic slug as there is the chance an eye might be injured.

If possible, it is best to fire from a safe location, such as a building entrance or vehicle, and to have a back-up person with a loaded shotgun. If a back-up is not available, it is possible to be your own back-up by placing 4-6 lead slugs (depending on shotgun) in the magazine and manually loading any plastic slugs to be fired. This enables the shooter to inject a lead slug quickly into the chamber of the shotgun if it becomes necessary. The same back-up technique can be used for cracker shells. The speed of a charging bear should never be underestimated and it is always advisable to be prepared for the worst situation.

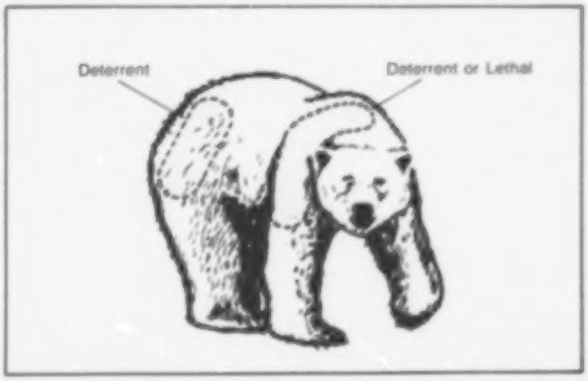

Figure 4. Placement of deterrent and lethal hits on bears.

To help identify where the bear is hit and also mark the bear, a small amount of paste shoe polish can be applied to the tip of the plastic slug. Depending on the colour of the bear, white or black shoe polish or a similar material can be used. The shoe polish on the plastic slug will make a mark approximately 4 x 4 cm. By hitting each bear in a different spot (front shoulder, rump, right or left side), individual bears can be identified and the results of the deterrent attempts assessed.

DESTROYING BEARS

Not all bears can be deterred and not all situations are appropriate for a deterrent attempt. When there is a shortage of natural foods, hunger may cause some bears to become aggressive in their attempts to acquire food. Other bears may become habituated to people or to human food and garbage and become aggressive. Such bears are not readily deterred and are often destroyed when they threaten human life or property. All measures should be taken to avoid destroying a bear. However, if a bear needs to be destroyed, it should be done as safely and as humanely as possible.

The twelve gauge shotgun with lead slugs can be used to kill a bear at close range (0-30 m) (Figure 2). The twelve gauge slug is recommended over buckshot for destroying a bear based on finding by Meehan and Thilenius (1983). During their tests they found no advantage to using 00 buckshot and concluded that at 13.5 m or further, the buckshot would probably only wound a bear, as the penetration was only 5 - 7.5 cm over a 30 x 30-cm area. Killing a bear at greater distances (over 30 m) may be done more effectively with a large calibre high powered rifle.

When shooting to kill a bear, aim at the front shoulders/vital organ area (Figure 4). A hit anywhere in this area should be a disabling and lethal shot. Be prepared to continue shooting until the bear is dead. A wounded bear is dangerous and must be destroyed immediately. If a bear is destroyed, the appropriate agencies must be contacted and the bear hide salvaged and surrendered. The carcass should be properly disposed of.

SUMMARY

The twelve gauge pump shotgun is an effective, versatile weapon for deterring or destroying bears. Using a combination of cracker shells and plastic and lead slugs will help people in remote areas to effectively manage bear problems. Deterring bears before they receive a food reward may save some bears that otherwise eventually might be destroyed.

Although the shotgun can be used to deter or destroy problem bears, its use must be taught in conjunction with other aspects of bear safety, such as an understanding of bear biology, the causes and prevention of bear-people conflicts, proper techniques for handling food and garbage, and methods for dealing with any problems that develop despite precautions. A comprehensive approach to bear safety should help people to coexist with bears in bear country.

LITERATURE CITED

BROMLEY, M. 1985. Safety in bear country: a reference manual. NWT Dept. of Renewable Resources, Yellowknife, 120 pp.

CLARKSON, P. L. 1987. Bear deterrent study, Cape Churchill, Manitoba, 1986. NWT Dept. of Renewable Resources, Yellowknife. File rep. No. 66. 58 pp.

_____. 1988. The status and management of the black bear in the Northwest Territories, Canada, 1986. Proc. third western black bear workshop, Univ. of Montana, Missoula, April 1985. In prep.

_____. In Prep. Bear deterrent study, Cape Churchill, Manitoba, 1986. NWT Dept. of Renewable Resources, Yellowknife. File Rep.

DALLE-MOLLE, J. L., and S. MILLER. 1989. Bear-people conflict management in Denali National Park, Alaska. Pages 129-132 *in*: NWT Dept. of Renewable Resources, Bear-people conflict: proceedings of a symposium on management strategies.

DEROCHER, A. E., and S. MILLER. 1986. Twelve gauge ferret shell tests on polar bears, Cape Churchill, Manitoba, 1984. NWT Dept. of Renewable Resources, Yellowknife. File Rep. No. 54. 40 pp.

LEONARD, R. D. 1989. Polar bear-human conflict on the national historic park and sites in the Churchill area. Pages 75-82 *in* NWT Dept. of Renewable Resources, Bear-people conflicts: proceedings of a symposium on management strategies. Yellowknife, N.W.T.

MEEHAN, W. R., and J. F. THILENIUS. 1983. Safety in bear country: protective measures and bullet performance at short range. USDA Forest Serv. Gen. Tech. Rep. PNW-152. 16 pp.

MILLER, S. J., N. BARICHELLO, and D. TAIT. 1982. The grizzly bears of the Mackenzie Mountains, Northwest Territories. NWT Wildlife Serv., Yellowknife. Completion Rep. No. 3. 118 pp.

NAGY, J. A., R. H. RUSSEL, A. M. PEARSON, M. C. KINGSLEY, and B. C. GOSKI. 1983. A study of grizzly bears on the barren grounds of Tuktoyaktuk Peninsula and Richards Island, Northwest Territories, 1974-1978. Unpubl. Can. Wildl. Serv. Rep., Edmonton.

STENHOUSE, G. B. 1982. Bear detection and deterrent study, Cape Churchill, Manitoba, 1981. NWT Dept. of Renewable Resources, Yellowknife. File Rep. No. 3. 65 pp.

_____. 1983. Bear detection and deterrent study, Cape Churchill, Manitoba, 1982. NWT Dept. of Renewable Resources, Yellowknife. File Rep. No. 37. 58 pp.

_____, and M. CATTET. 1984. Bear detection and deterrent study, Cape Churchill, Manitoba, 1983. NWT Dept. of Renewable Resources, Yellowknife. File Rep. No. 44. 59 pp.

STIRLING, I. 1975. Summary of fatality involving a polar bear attack in the Mackenzie Delta, January 1985. Can. Wildl. Serv. Polar Bear Proj. Spec. Rep. 89. 2 pp.

URQUHART, D., and R. SCHWEINSBURG. 1984. Polar bear life history and distribution in the Northwest Territories up to 1981. NWT Dept. of Renewable Resources, Yellowknife. 70 pp.

WOOLDRIDGE, D. R. 1984. The "Ferret" 12 gauge soft-slug as a black bear deterrent. Proc. 1984 Predator Symposium, Univ. of Montana, Missoula.

A REVIEW OF BEAR DETECTION SYTEMS

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Abstract: A bear detection system is an important component of any strategy designed to minimize or eliminate bear-people conflicts. A number of detection systems have been tested in the last 10 years, including proximity detection units, trip-wire fence systems, a microwave motion detection unit, an infrared detection unit, dogs and bear monitors. This paper briefly describes the research, and provides a summary of the advantages and limitations of each detection technique.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Industrial exploration and development and community expansion have increased significantly throughout North America in the last 20 years (Clarkson et al. 1985). This has resulted in a corresponding increase in the number of bear-people conflicts. Bears are attracted to people by curiosity (Bacon 1980, Stenhouse and Cattet 1984), odours associated with food storage and preparation (Herrero 1976, Stenhouse 1983, Tietje and Ruff 1983), and waste disposal.

Bear-people problems concern industry, the public, and government agencies responsible for bear management programs because conflicts often result in human injury or death, property damage, and/or the death of the bear (Clarkson et al. 1985). People living and working in bear country need to take a proactive approach to problem bear management.

Considerable research has been completed in the last 10 years to identify and/or develop practical techniques to prevent, minimize, or eliminate bear-people conflicts. Other aspects include deterrent systems, and training and education. Most research has been completed on polar bears (*Ursus maritimus*); however, many of the techniques described can be used in black bear (*U. americanus*) and grizzly bear (*U. arctos*) habitat.

Many of the detection techniques reviewed have been identified and tested under the auspices of the Northwest Territories "Safety in Bear Country Program", which was supported by the Government of the Northwest Territories; Manitoba Department of Natural Resources; Canadian Wildlife Service; Indian and Northern Affairs Canada; Energy Mines and Resources, Polar Continental Shelf Project; Dome Petroleum Ltd.; Esso Resources Canada Ltd.; Gulf Canada Resources Ltd.; Mobil Oil Ltd.; Petro-Canada Ltd.; Cominco Ltd.; and, B.P. Minerals Ltd. We thank Dr. Martin Lewis (York University, Toronto), Peter Clarkson (Government of the NWT, Inuvik), and Peter Croskery (Ontario Ministry of Natural Resources, Kenora) for reviewing initial drafts of the manuscript. In addition, we thank Sinni Tong for typing the manuscript.

DETECTION TECHNIQUES

Proximity Detection Unit

The proximity detection unit was tested by Wooldridge (1978) and Wooldridge and Gilbert (1979) in Manitoba. This device is based on the principle that an electric field changes within a predetermined distance from a receiving system as a bear approaches. The detector was designed to amplify small changes in the electric field of a charged antenna. Testing was discontinued because the detection system was unreliable. The system was not recommended for use in detecting intruding bears.

Trip-Wire Detection System

Wooldridge (1978) tested at trip-wire fence system in northern Manitoba and in the Beaufort Sea. Stenhouse (1983) tested a modified version of the system developed by Wooldridge (1978). The trip-wire fence system works on the "break-connection" principle (Stenhouse 1982). A bear walks through the fence, breaks the wire and trips an alarm (Bromley 1985).

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Wooldridge (1978) used 22-gauge, 7-strand nylon-coated wire, which was tightened to minimize sag. The wire was strung around a perimeter and the success rate was measured as the number of observed bears tripping the alarm as they penetrated the perimeter. Wooldridge (1978, 1980) and Wooldridge and Gilbert (1979) tested single, double, and triple strand fences. Single and double strand trip-wire fence systems detected all of the bears ($N = 42$) breaking through the perimeter during the 1977 studies, and 42 of 58 (78%) intruding bears in 1978. Single and double strand trip-wire fences required reconnection and repair after each intrusion because contact with the bear caused a separation of the in-line plug and the jack. In 1979, 37 (90%) of 41 bears were detected by the double strand trip-wire fence while 34 (94%) of 36 bears were detected by the triple strand trip-wire micro-switch system (Wooldridge 1978, Wooldridge and Gilbert 1979). Wooldridge (1978) and Wooldridge and Gilbert (1979) identified the following problems with the trip-wire fence system:

1. Wind and frost loads caused false alarms.
2. Bears learned to crawl under and leap over the trip-wire fence.
3. The fence demonstrated wear under field conditions and required a lot of maintenance.

Wooldridge (1980, 1983) concluded that the trip-wire system, despite problems, showed considerable promise as a detection system for small, temporary camps.

Stenhouse (1983) tested a modified trip-wire fence system, which was synchronized with an audio-alarm kept in the occupied tent or building. Stenhouse (1983) made modifications to the trip-wire design tested by Wooldridge (1978, 1980) and Wooldridge and Gilbert (1979) by incorporating:

1. A simplified electronic circuitry system with multiple channel capability (Figure 1).
2. An external battery to alleviate cold weather problems.
3. A durable and all-weather housing for the circuitry.

Stenhouse (1983) used 20-gauge plastic-coated electrical wire strung through eyelets on corner posts. Each 20-gauge wire lead was attached to the alarm terminal board and an audio-alarm, both contained in the all-weather housing (Figure 2). Stenhouse (1983) detected all observed bears ($N = 50$) which breached the perimeter. No false alarms were recorded. He concluded that the modified trip-wire fence system has the following advantages:

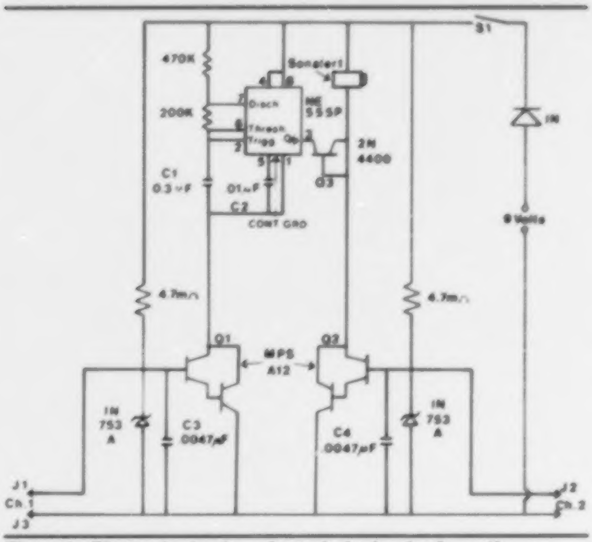

Figure 1. Electronic circuitry of a typical trip-wire fence (from Stenhouse 1983).

1. It does not require a large number of materials.
2. It is inexpensive.
3. It is reliable and durable.
4. It is not susceptible to wind and frost load.
5. It is practical for small, mobile camps.

Bromley (1985) suggests that the fence perimeter be large enough to allow people time to respond to the alarm, and recommends that the perimeter extend 10 m from all sides of the camp (Figure 3).

Microwave Motion Detection Units

Stenhouse (1982, 1983) designed and conducted all of the microwave motion detection tests. Microwave systems (outdoor perimeter motion detection units) are used for security in prisons and nuclear power plants. The model tested was a cold weather unit designed to operate at temperatures as low as -40°C (Stenhouse 1982). The units operate as a bistatic system whereby the transmitter and receiver are mounted on posts and positioned at opposite ends of the perimeter (Figure 4). An RF signal is continuously transmitted to the receiver. Penetration of the perimeter by an intruder causes detectable signal variations, which are processed by a

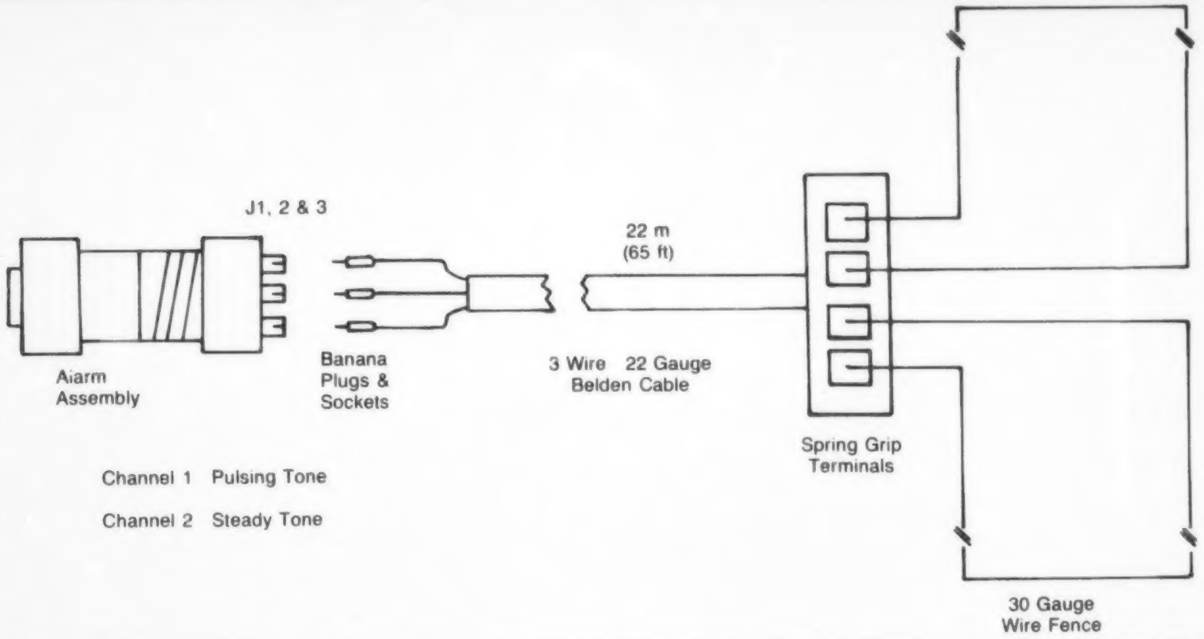
J1, 2 & 3
22 m
(65 ft)
Alarm
Assembly
Banana
Plugs &
Sockets
3 Wire 22 Gauge
Belden Cable
Spring Grip
Terminals
Channel 1 Pulsing Tone
Channel 2 Steady Tone
30 Gauge
Wire Fence

Figure 2. Trip-wire fence system (from Stenhouse 1983)

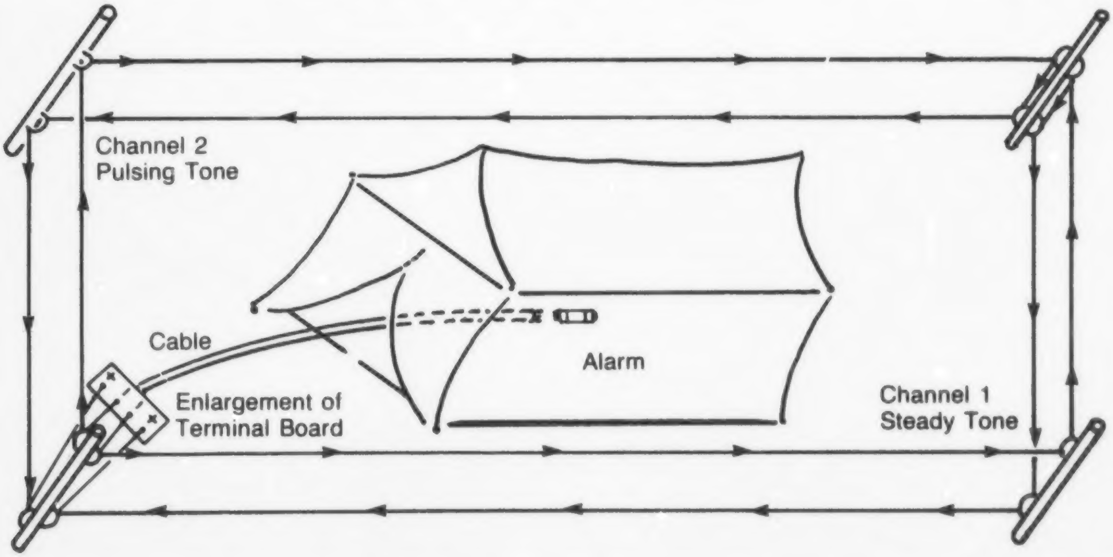
Channel 2
Pulsing Tone
Cable
Alarm
Enlargement of
Terminal Board
Channel 1
Steady Tone

Figure 3. Recommended installation of a typical trip-wire fence (from Bromley 1985).

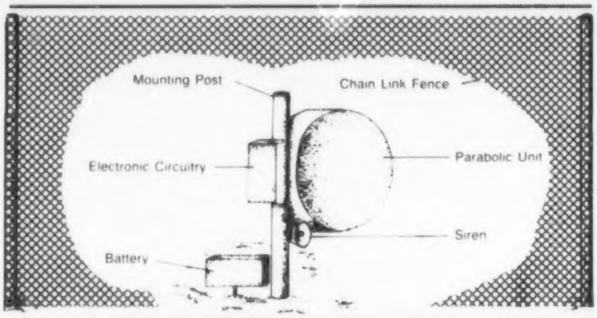
Mounting Post
Chain Link Fence
Electronic Circuitry
Parabolic Unit
Siren
Battery

Figure 4. Mounting of the microwave transmitter/receiver (from Stenhouse 1983).

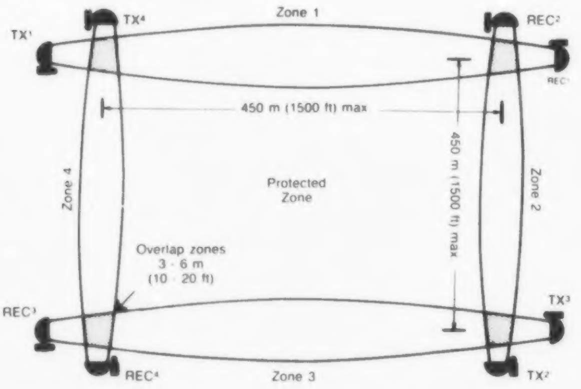
TX^1
TX^4
Zone 1
REC^2
REC^1
450 m (1500 ft) max
Zone 4
Protected Zone
450 m (1500 ft) max
Zone 2
Overlap zones 3 - 6 m (10 - 20 ft)
REC^3
TX^3
REC^4
Zone 3
TX^2

Figure 5. Installation of the microwave units for maximum camp protection (from Bromley 1985).

trigger alarm relay. Alteration of the signal activates an audio warning and a light.

Stenhouse (1982, 1983) used 18-gauge coaxial cable to connect the receiver units to the control panel. The effective operating range of the unit tested was 456 m (Figure 5). The unit is normally powered by AC current; however, Stenhouse (1982) used a 12-volt car battery (1 battery per unit) (Delco 625 amp). All observed bears were detected in 1981 (N=66) and in 1982 (N=187) (Stenhouse 1982, 1983).

Stenhouse (1982, 1983) recommended the use of the microwave unit for medium-sized camps and installations, and identified the following advantages of the unit:

1. It is not adversely affected by snow, rain or fog.
2. It is reliable.
3. It detects bears night and day.

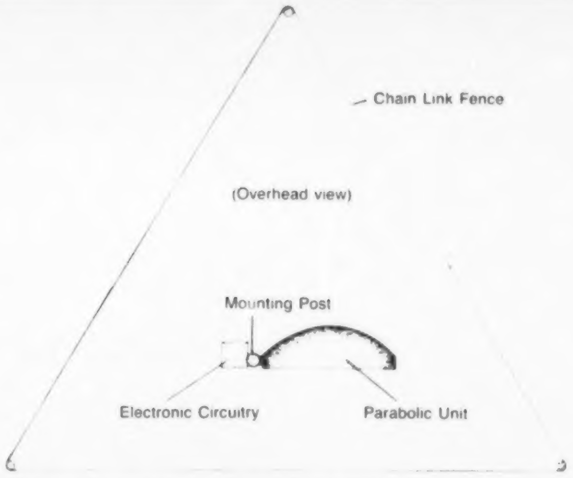
Chain Link Fence
(Overhead view)
Mounting Post
Electronic Circuitry
Parabolic Unit

Figure 6. Bear-proof exclosure for the microwave units (Stenhouse 1983).

4. It requires little maintenance.
5. It can be reset with minimum effort, although daily tests are recommended.
6. It is simple to install.

Stenhouse (1982, 1983) also identified the following limitations:

1. The batteries require charging every 3 days unless AC current is available.
2. Other animals can trip the alarm.
3. Bears attempt to chew the plexiglass face plates and can misalign the units. Bear-proof housing must be constructed (Figure 6).
4. The unit is limited to a perimeter distance of 456 m. A larger perimeter requires microwave units hooked in tandem.
5. The coaxial cable must be hidden and protected from bears.
6. Irregular terrain reduces the effectiveness of the unit. The manufacturer recommends that terrain variation within the detection zone not exceed 15 cm, and ground cover not exceed 10 cm (Bromley 1985).

Infrared Thermography

Fitch (1985) completed a preliminary study at the Beaufort Sea, and Fitch and Hoos (1986) conducted experiments at Cape Churchill, Manitoba to determine the feasibility of using infrared thermography to detect polar bears and other wildlife species at large industrial camps and large installations surrounded by unstable ice (e.g., artificial islands). Technological development of infrared imagery has progressed rapidly in recent years. A reliable, portable system is now commercially available. The infrared system can be set up to automatically scan large areas. The size of the area is determined by the size of the camera lens.

The detection unit tested by Fitch and Hoos (1986) contained a sensing tube or a hard pyroelectric videcon (PEV) linked to an audible warning system, which allowed field workers to activate a video cassette data recorder when bears approached. The detector accepts infrared radiation through a special germanium lens, which converts information to a monochromatic tone on a built-in monitor (Figure 7). The analogue presentation appears in scales of grey tone, similar to the picture generated by a black and white television.

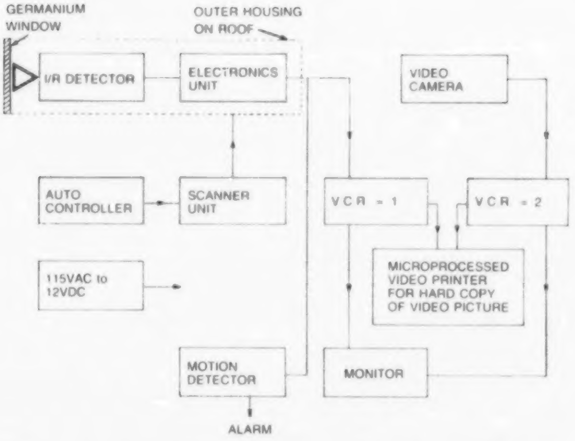

Figure 7. Flow chart of infrared system used at Cape Churchill, Manitoba, 1984 (from Fitch and Hoos 1986).

Each tone denotes a specific surface temperature; black tones signal cool temperatures and white tones signal warm temperatures. The system detects heat in the 8-14 micron band, although other frequencies can be detected at reduced efficiency (Fitch 1985).

At Cape Churchill, the chamber was housed in an all-weather plexiglass box and mounted on the top of a 13.5 m research tower. Tests were conducted during dark and light periods and under a variety of weather conditions. All bears which penetrated the perimeter were detected (Fitch and Hoos 1986). The detection capabilities of the system were not affected by temperatures as low as -17°C and winds of up to 80 km/hr.

Fitch and Hoos (1986) recommended the use of the infrared detection system for large installations used by humans, and listed the following advantages:

1. The system is portable and compact because it does not require liquid nitrogen.
2. It is self-powered (nicad batteries), extremely versatile, and records directly into a video cassette recorder.
3. The system contains a built-in monitor.
4. The system can be interfaced with a microcomputer.
5. It is reliable if correctly housed and correctly mounted.
6. The system can be served without risk to workers.

The system is expensive and should be operated by trained personnel; however, companies not able to purchase a system might enter into a leasing agreement with distributors.

Other Detection Systems

A number of commercially available security systems which could function as bear detection systems are available. Although we have not tested them, and cannot provide scientific evaluations, they include the modulated light beam and the LASER.

LASER is the acronym for "Light Amplification through Stimulated Emission of Radiation". A LASER works on the principle that an active substance can be stimulated to emit radiation in the form of a light beam. Wooldridge (1980) conducted preliminary experiments with a Radionics Helium-Neon Gas LASER.

Wooldridge (1980) determined the effective range of this unit during periods of clear air to be 4 km and during periods of heavy snow to be 1 km. He suggested that LASERS may be appropriate as detection systems for offshore islands (oil and gas exploration); however, this system has not been tested with bears.

Dog and Bear Monitors

Dogs are a time-honoured method of detecting bears. Historically, the Canadian Inuit used Eskimo dogs to assist in polar bear hunts and to alert people of bears approaching the camp (Carpenter 1980). In fact, dogs have proven to be a practical method of detecting and deterring predators under a variety of conditions (Green et al. 1984). Dogs used to detect bears should be well trained, and when used in small or medium sized camps, should be tied up when not on patrol with a handler (Figure 8). Free-ranging dogs could bring a bear back to camp. Carpenter (1989) discusses the use of free-ranging dogs in association with 8 large installations. Although this approach has disadvantages, it may be the most appropriate technique for large installations.

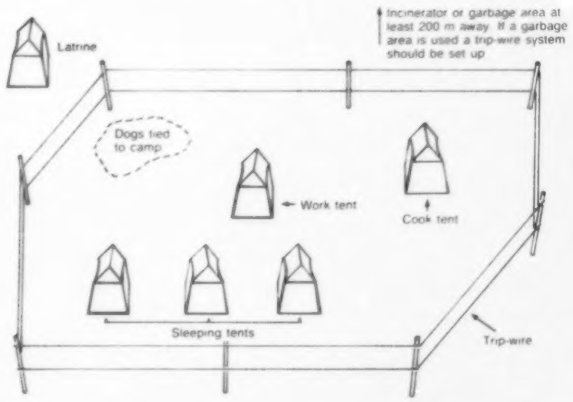
Latrine
Incinerator or garbage area at least 200 m away. If a garbage area is used a trip-wire system should be set up
Dogs tied to camp
Work tent
Cook tent
Sleeping tents
Trip-wire

Figure 8. Recommended design of a long-term camp (from Bromley 1985).

Bear monitors have been successfully employed to protect camps and installations in the Canadian Arctic. In the Beaufort Sea, Inuit hunters are hired as bear monitors to patrol, by snowmobile, the area surrounding the installation. The monitor is responsible for detecting any polar bears approaching the installation, and if necessary, deterring or destroying intruding bears. At the Polaris Mine on Little Cornwallis Island, NWT, the bear monitor has worked with Eskimo Dogs. Monitors should be experienced in hunting polar bears and in handling dogs, should be trained in detection and deterrent techniques, and should work according to a management plan which contains contingency plans should problems occur.

Conventional Detection Techniques

In addition to specialized equipment and techniques, a number of simple and inexpensive procedures can be used to detect bears (Bromley 1985) (Figure 9):

1. Install flood lights in outside work areas.
2. Ensure that all doors are outfitted with durable windows so that workers can scan the immediate area before leaving the building.
3. Remove brush around buildings and eliminate access to areas underneath buildings.
4. Always work in teams, and ensure that one member of the crew is solely responsible for detecting bears.
5. While working away from camp at night, use a spotlight or vehicle lights.
6. Always carry a radio to receive and transmit information about bears.
7. Report all bear tracks and sightings.

DISCUSSION

There is no magic solution or device which will eliminate bear-people conflicts; a detection technique which works in one situation may not necessarily work in another situation. Each encounter between bears and people is unique, depending on the season; time of day; surrounding landscape; experience of the bear with people; experience of the people with bears; the disposition, physical condition, age, species, and curiosity of the bear; the presence of cubs; the camp design and layout; the strength of the attractant (e.g., garbage); and the availability of equipment to detect, deter, and/or kill the bear. The solution lies in developing a variety of techniques which can be selected by people living and working in bear country to meet their specific needs. Prior to purchasing or leasing any detection system, users should evaluate its effectiveness and practicability in the context of the environmental conditions in which they will operate. Education is a critical component of a successful "Safety in Bear Country Program", and is recommended for all people who may be required to deal with a problem bear.

Personnel designated to manage the bear program on behalf of the camp, community, or installation must be well trained to facilitate purchase and maintenance of the equipment, and to establish and implement the program. Staff must understand bear ecology and behaviour, and techniques to minimize or eliminate the probability of bear-people encounters through correct camp design and maintenance.

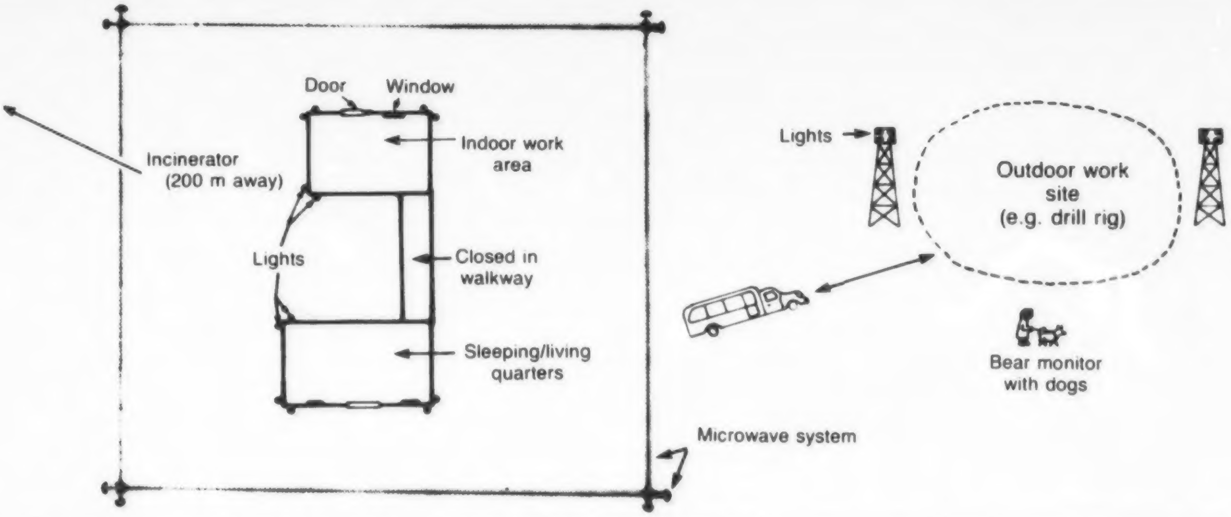

Figure 9. Recommended design for a large, permanent industrial site (from Bromley 1985).

LITERATURE CITED

BACON, E. S. 1980. Curiosity in the American Black bear. Int. Conf. Bear Res. and Manage. 4:153-166.

BROMLEY, M. 1985. Safety in bear country: a reference manual. NWT Dept. of Renewable Resources, Yellowknife.

CARPENTER, W. J. 1980. A bear deterrent program for Polaris Mine. Little Cornwallis Island, NWT. Eskimo Dog Res. Found., Yellowknife. 5 pp.

_____. 1989. The Canadian Eskimo dog: the original defence against the polar bear. (Abstract only). Page 71 *in* Northwest Territories Dept. of Renewable Resources, Bear-people conflicts: proc. of a symposium on management strategies.

CLARKSON, P. L., P. A. GRAY, J. E. McCOMISKEY, L. R. QUAIFE, and J. G. WARD. 1985. Managing bear problems in northern development areas. Proc. 8th Ann. Meet. Int. Soc. Petro. Ind. Bio.: 47-54.

FITCH, R. 1985. Report on aerial infra-red tests for remote sensing of polar bears (*Ursus maritimus*) and grizzly bears (*Ursus arctos*), Tuktoyaktuk, May 1985. Rep. to the NWT Wildl. Serv., Yellowknife, NWT. 25 pp.

_____, and L. M. HOOS. 1986. A study to evaluate infra-red thermography techniques for detecting polar bears (*Ursus maritimus*) at Cape Churchill, Manitoba, November, 1984. Pages 2-23 *in* Infra-red detection and acoustic deterrent study, Cape Churchill, Manitoba, 1984. NWT Dept. of Renewable Resources, Yellowknife. File Rep. No. 55. 49 pp.

GREEN, J. S., R. A. WOODRUFF, and T. T. TUELLER. 1984. Livestock-guarding dogs for predator control: costs, benefits, and practicality. Wildl. Soc. Bull. 12(1): 44-50.

HERRERO, S. 1976. Conflicts between man and grizzly bears in national parks in North America. Int. Conf. Bear Res. and Manage. 3:121-145.

STENHOUSE, G. B. 1982. Bear detection and deterrent study, Cape Churchill, Manitoba, 1981. NWT Dept. of Renewable Resources, Yellowknife. File Rep. No. 23. 64 pp.

_____. 1983. Bear detection and deterrent study, Cape Churchill, Manitoba, 1982. NWT Dept. of Renewable Resources, Yellowknife. File Rep. No. 37. 58 pp.

_____, and M. CATTET. 1984. Bear detection and deterrent study, Cape Churchill, Manitoba, 1983. NWT Dept. of Renewable Resources, Yellowknife. File Rep. No. 44. 59 pp.

TIETJE, W. D., and R. L. RUFF. 1983. Responses of black bears to oil development in Alberta. Wildl. Soc. Bull. 11(2): 99-112.

WOOLDRIDGE, D. R. 1978. Deterrent and detection systems. Rep. to Gov. NWT, Yellowknife, NWT. 55 pp.

_____. 1980. A field study of electronic polar bear detection and deterrent devices: Churchill, 1980. Rep. to Gov. NWT, Yellowknife, NWT. 60 pp.

_____. 1983. Polar bear electronic deterrent and detection systems. Int. Conf. Bear Res. and Manage. 5:264-269.

_____, and B. K. GILBERT. 1979. Polar bear detection and deterrent systems. Rep. to the Gov. NWT, Yellowknife, NWT. 37 pp.

AN ELECTRIC FENCE THAT DOES DETER POLAR BEARS

(Abstract Only)

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R. F. ROCKWELL, City College, New York, NY, USA

Abstract: In 1984, we built an electric fence around the Queen's University Tundra Biology Station (QUTBS) that was designed to act as both a deterrent and warning system for polar bears. Through 2 full field seasons (1984 and 1985) the fence has been 100% successful as a deterrent. In this paper I describe the system we have used; why it works at QUTBS; and how it might be modified to work under different field conditions.

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THE CANADIAN ESKIMO DOG: THE ORIGINAL DEFENCE AGAINST THE POLAR BEAR

(Abstract Only)

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Abstract: The Canadian Eskimo dog is an aboriginal breed of dog that the Inuit of Arctic Canada call "Qimmiq". The breed has a 1,000-year history of being interdependent with the Thule culture who, following the Dorset culture, occupied the coastal and archipelago area of what is now Arctic Canada. Although it is a member of the spitz family of dogs, the Canadian Eskimo Dog's origin is lost in Inuit prehistory, which includes the migration of the Mongolian race from the Asian continent to North America. For centuries this dog was used as a draft animal and as a hunting dog. As a hunting dog it would also attack and hold polar bears at bay for the Inuit hunters. The temperament of the Canadian Eskimo Dog reflects a tough, hard-working breed. The dog is very pack-oriented and, compared to modern domestic breeds, tends to over-respond to any stimulus whether it be food, work, fighting, or hunting. For this reason the dog is ideally suited for deterring the polar bear and has been known to aggressively attack bears with little fear for its own life. This historic use of this breed of dog as a hunter of polar bears is well documented in Inuit history and legend. In modern times, the dog can be used as a bear deterrent at industrial sites in the Canadian North. Use of Eskimo Dogs can be one element in a bear deterrent program that also includes education and regular patrols to guard against intruding bears.

The author is greatly indebted to the many Inuit of northern Canada who so eagerly provided not only their dogs for the breeding program of the William J. Carpenter Eskimo Dog Research Foundation, but gave all the information they could concerning the historic use of dogs in their culture. In particular, I will forever remember some of those great dog drivers like the Immoroituks (Emile, Joseph, and Katherine), Maliki, Takaugak, Uluapik, Akatatsiak, Taqaugaq, Idlout, Attagutalalukutuk, Simone Alinga, and Attagutalukutuk. A very special thank you is also extended to elders such as Kopak who still drives dogs and Pewogatok now in his 80's. These two men not only supplied dogs, but with the assistance of George Qulaut as interpreter and recorder, are involved in the Igloolik Elders Project. The work of the foundation was funded by the Governments of the Northwest Territories and Canada as well as the Canada Council Explorations Program and the Canadian Kennel Club. Other support came from the Katimavik Youth Program, Employment Canada and thousands of individuals too numerous to mention, with the exception of John McGrath and Ken MacRury.

DANGEROUS BEAR POLICY AND THE ESTABLISHMENT OF BEAR RESPONSE TEAMS IN ALBERTA

(Abstract Only)

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Abstract: On September 15, 1979, a Cardston, Alberta hunter was attacked by a grizzly bear in North Mill Creek Canyon at the base of the North Castle Peak. He died of his injuries the following day. The fatality inquiry, which was conducted as a result of the death, recommended that a task force be formed to consider divisional responsibilities in such incidents. This task force was formed in 1980. It recommended that Bear Response Teams be formed to respond to similar incidents by capturing and removing the responsible bear quickly and safely. It further recommended that these teams be supplied with equipment kits to effect this control. The Dangerous Bear Policy, which called for the formation of these teams, came into effect June 19th, 1985. Five team leaders were selected from officer staff having the greatest expertise, and bear response equipment kits were assembled and placed at strategic locations in the province. Kits are located at Pincher Creek, Rocky Mountain House, Edson, Grande Prairie and Lac La Biche. Bear response equipment kits contain all the equipment that is likely to be required to locate, capture, and remove a target bear. Special training was provided to response team leaders in 1985, and that training will be required in the future for all officer staff who will be expected to act as response team members. Five dangerous bear incidents were handled by Bear Response Teams in 1985. Two of these involved human injury from attack; the others involved the possibility of injury to humans. All of these incidents were successfully resolved.

SECTION III. PROBLEM BEAR MANAGEMENT PROGRAMS

CHAIRMAN: DR. IAN STIRLING, Research Scientist, Canadian Wildlife Service, Edmonton, Alberta

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POLAR BEAR-HUMAN CONFLICT ON THE NATIONAL HISTORIC PARK AND SITES IN THE CHURCHILL AREA

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Abstract: From 1981 to 1984, 142 polar bears (*Ursus maritimus*) were involved in 92 occurrences on Fort Prince of Wales National Historic Park and Cape Merry and Sloop's Cove National Historic Sites. The 4-week period from 16 July to 15 August accounted for 72% of the total occurrences and 73% of the total number of bears involved. The presence of whale carrion in 1983 resulted in more use of the park and sites by bears, a greater number of bears per occurrence, more frequent need for use of deterrents, a higher probability that bears and visitors would occupy areas concurrently, and possibly presence of a higher number of sows with young. Methods of handling occurrences varied depending on site characteristics. Deterrents were applied in 33 of 92 occurrences. Close approach on foot and use of cracker shells fired from shotguns were applied in 23 of these 33 occurrences. One bear demonstrated behavioural habituation to cracker shells and was difficult to remove from the site. Other bears readily left the area or retreated to areas where their activity could be monitored while visitors used the site. The success of the program was attributed to the general lack of food in the area, the proximity of water as escape routes for bears, the geography of the park and sites which allows bears to be forced to natural loafing areas, and possibly the young ages and inexperience of some of the bears involved.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

The western Hudson Bay population of polar bears spends several months on land because the ice cover of Hudson Bay melts completely in summer (Stirling et al. 1977). These bears are not adapted to foraging on terrestrial resources and their food intake is limited both in quantity (Russell 1975) and probably quality. This population has had a long history of interaction with humans during the wait for formation of bay ice from early July to early November. Stirling et al. (1977) summarized the management problems and solutions that occurred during early years. In general, the number of humans killed or injured by polar bears in this area has been remarkably low considering the proximity that bears and humans share for a good portion of the year (Stirling et al. 1977).

The Canadian Parks Service manages Fort Prince of Wales National Historic Park and Cape Merry and Sloop's Cove National Historic Sites west of the town of Churchill (Figure 1). Protection of the historic resources and encouragement of public use and education through interpretive programs are the main management objectives for these areas. Consequently, a bear management program evolved to provide safety for the visiting public, since polar bears commonly use the park and sites during ice-free periods. The program involves detecting polar bears on or near the park and sites and deterring bears, using a number of methods, to allow safe use of the area by Interpretive staff and visitors. This paper describes the management of bear-human conflict at the park and sites and evaluates the effectiveness of procedures implemented.

I would like to extend my thanks to a number of people. Superintendent Donna Bland showed keen interest in bear management and arranged for a field trip during July 1983. Greg Rennie provided much helpful information on the procedures that were implemented. Brian MacDonald made many useful comments on the program.

METHODS

Study Area and Visitor Use

Cape Merry is accessible by road from Churchill, while Fort Prince of Wales and Sloop's Cove can only be reached by boat (Figure 1). Moderately strong tides influence both the timing and length of visits at these sites. Facilities at Fort Prince of Wales and Cape Merry include picnic areas with tables and garbage containers, pit privies, and visitor kiosks (small plywood structures). Garbage containers and pit privies are serviced on a daily basis. There are no facilities at Sloop's Cove.

Visitor use varies markedly among sites. Large numbers of people visit Cape Merry on tours or on their own accord. Tour companies transport groups across the Churchill River to Fort Prince of Wales and, to a lesser extent, Sloop's Cove. Visits to Fort Prince of Wales during visitor hours (depending on tides, but about 6 hours/day) generally include an interpretive tour of the fort. After visitor hours, tour operators bring visitors to the vicinity of the fort, but Parks ensures the gates of the fort are locked to prevent entry of polar bears. Visitors generally spend much less time at Sloop's Cove than at Fort Prince of Wales or Cape Merry.

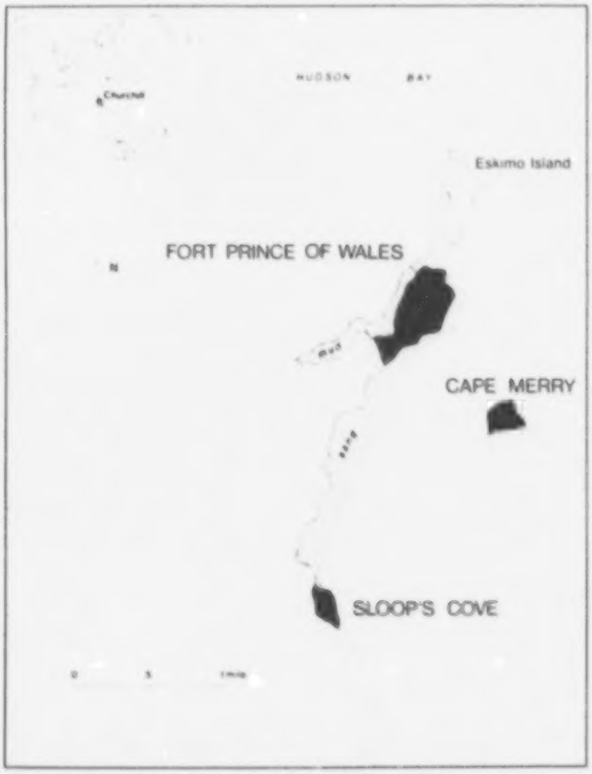

Figure 1. Locations of National Historic Park and Sites near Churchill, Manitoba.

Handling Bear-Human Conflict

Techniques for handling bear-human conflict have evolved over the last few years at the park and sites. Methods vary depending upon site characteristics. In all cases the program depends on public education, sanitation, and management action after bears are detected at the site (Leonard 1987). This analysis deals only with results of the latter phase of the program.

During periods when the park is occupied, Maintenance and Security (M & S) staff and Interpretive staff detect and handle conflicts and control visitors, respectively. Cape Merry is occupied 0800-1600 hrs, 7 days a week, from about 5 June to 11 September. Staff arrive by truck before opening the park to visitors. Interpretive staff stay in the vehicles or kiosk to maintain radio contact. The M & S staff walk the high ground around the area and do a thorough check for bears. If no bears are sighted, a radio message to Interpretive staff is given indicating that they may begin a guided tour. Spot checks are made every half-hour to detect bears that may have entered the site by land or water. After the first morning check is completed, a spotting scope is set up on high ground to examine the Fort Prince of Wales and Sloop's Cove areas. Additional M & S and Interpretive staff cross the river and repeat the security check at Fort Prince of Wales. This involves checking the shoreline, kiosk area, and the route to the fort, walking the wall of the fort, glassing the Eskimo Island area, and using a 3-wheel all-terrain vehicle to check the periphery of the fort and west part of the peninsula.

Polar bears may be detected in 3 different types of circumstances: (1) when M & S staff first inspect the park or sites; (2) when M & S and Interpretive staff are in the area alone; and (3) when M & S and Interpretive staff are in the area with visitors. In the above cases, the management actions related directly to the bears do not change, although controlling visitor activity is given the highest priority in the third case. If human presence in the form of vehicle, boat, or foot travel does not deter bears from the park or site, M & S staff will attempt to use a variety of deterrents to frighten the bear(s) from the area after visitor activity is brought under control. Use of deterrents depends upon the situation and the characteristics of the park or site involved. The objective is to force a bear off the park or site to an area where the animal will retreat or where it can be watched at a safe distance. At Cape Merry bears are deterred into Hudson Bay or the Churchill River. At Fort Prince of Wales bears are deterred into the bay, or onto Eskimo Island or, when there are no other options, they are forced inland. Bears are not deterred from Sloop's Cove.

M & S staff work alone or in pairs to deter bears, depending on the availability of staff. When working in pairs, one individual uses live ammunition in a shotgun (slugs or 00 buckshot) and the other uses cracker shells. Cracker shells are fired at a distance of about 400 m from a bear that is to be deterred. If the bear does not move, more cracker shells are fired at 200 m. When working alone, M & S staff approach bears to within 50 m to 100 m, if necessary. Assistance from the Royal Canadian Mounted Police or Provincial Conservation Officer is requested if closer approach is required. Distances of less than 20-30 m are avoided in most situations because aggressive bear behaviour such as huffing, jaw movements, vocalizations, and head swinging and bobbing become evident. An air horn is sometimes used between cracker shell blasts. In cases where bears cannot be moved by these deterrents from beluga whale (*Delphinapterus leucas*) carcasses, a helicopter may be used to frighten bears from the site to allow eventual disposal of attractants.

Data Base, Analysis, and Definitions

Standardized forms were prepared and distributed to M & S staff in 1982. These forms allowed general data on date, location, action of bear, and action of people to be gathered. For 1983 and 1984, a revised form was provided which included more details in the above categories as well as data on factors attracting bears. In 1982-1984 ample space was provided for written descriptions of the situation and management action. In 1981, no standard forms were used, but M & S staff kept records of date, time, location, number of bears reported or sighted, and management action implemented.

Data from 1981 were believed to be incomplete because not all bears observed were reported. Data from 1982-1984 are more complete, although it is possible that a few records were not included. All records were transcribed onto appendices that apportioned information into relevant categories. Analyses of these categories resulted in tables detailing important aspects of the bear-human conflict on the park and sites. No statistical analysis was applied to the data.

Solitary bears, although likely subadult males, were recorded as bears of unknown age and sex. Females were recorded as being with 1 or 2 unclassified young, because distinction between cubs and yearlings was not always reliable.

A number of definitions are required to understand the categories selected. An observation of 1 or more bears at a park or site is termed an *occurrence*. If bears are frightened away and the same or additional bears return on the same day, a second *occurrence* takes place. A *management action* is the action taken by M & S staff after a bear is detected on the park or sites. These actions are classed into 2 groups: *observe/monitor* - which means no attempts at moving the bear take place at any time; or *deter* - which means attempts are made to frighten bears from the area or to a location where they can be safely watched. Because there is a fine line between unintentional use of deterrents (e.g., human presence in truck or boat) and planned use of deterrents (e.g., cracker shells, helicopter) *deter* action was classified as either: *passive* - which means presence of humans on foot, or in a vehicle or boat was sufficient to deter bears; or *active* - which means a scaring method, such as cracker shells or aircraft hazing, was used to move bears from the park or sites. A single *management action* could be classed only into *observe/ monitor* or *deter*. If a bear was deterred to a location where its activities could be safely monitored, the management action was classed as *deter* only. Obvious factors or conditions involving food sources which enticed bears to the park or sites were called *attractants*. Other factors such as aspect and location near the Churchill River/ Estuary that could make the area favourable to bears were not considered attractants.

RESULTS

From 1981 to 1984, 142 polar bears were involved in a total of 92 occurrences on the National Historic Park and Sites. The 4-week period between 16 July and 15 August accounted for 72% of the total occurrences and 73% of the total number of bears involved (Table 1). During this 31-day period, bears were reported on 10, 13, 17, and 9 days in 1981, 1982, 1983, and 1984, respectively.

Management actions varied among sites, but differed little from year to year (Table 2). At Sloop's Cove, all occurrences were monitored and no deterrents were used. Conversely, all bears were deterred from Cape

Table 1. Temporal distribution of polar bear occurrences on Fort Prince of Wales, Cape Merry and Sloop's Cove National Park and Sites, Manitoba, 1981-1984.

Year	15-30 June		1-15 July		16-31 July		1-15 August		16-13 August		
1981			5[a]	(42)	2	(16)	5	(42)			
			10[b]	(59)	2	(12)	5	(29)			
1982					11	(58)	7	(37)	1	(5)	
					11	(52)	9	(43)	1	(5)	
1983			2	(6)	9	(26)	17	(50)	6	(18)	
			2	(3)	21	(33)	33	(52)	8	(13)	
1984	1	(4)	7	(26)	7	(26)	8	(30)	4	(15)	
	1	(3)	11	(28)	12	(30)	11	(28)	5	(13)	
Total Occurrences	1	(1)	14	(15)	29	(32)	37	(40)	11	(12)	92
Total No. of Bears	1	(1)	23	(16)	46	(32)	58	(41)	14	(10)	142

[a] Number of occurrences, and % of yearly total in parentheses.
[b] Number of bears, and % of yearly total in parentheses.

Table 2. Management actions implemented on polar bears by year and location, June - August, 1981-1984, Manitoba.

	Fort Prince of Wales					Cape Merry					Sloop's Cove				
	No. of Occurrences		Management Action			No. of Occurrences		Management Action			No. of Occurrences		Management Action		
			Observe/ Monitor	Deter				Observe/ Monitor	Deter				Observe/ Monitor	Deter	
				Passive	Active				Passive	Active				Passive	Active
1981	12	(17)[a]	9	N/A	3										
1982	15	(17)	10	1	4	4	(4)		3	1					
1983	22	(43)	15	2	5	9	(16)		1	8	3	(5)	3		
1984	23[b]	(360)	20	1	2	2	(2)			2	2	(2)	2		

[a] Number of bears.
[b] Includes one record from middle of Churchill River between sites.

Table 3. Management actions implemented on polar bears in relation to presence of visitors and presence of attractants at Fort Prince of Wales, Cape Merry, and Sloop's Cove National Historic Park and Sites, Manitoba, June - August, 1981-1984.

	No. of Occurrences	Occurrences with Attractants Present		Occurences with Visitors Present		Management Action					
								Deter			
						Observe/Monitor		-Passive-		-Active-	
		No.	%	No.	%	No.	%[a]	No.	%[a]	No.	%[a]
1981[b]	12	no data		no data		9	75	no data		3	25
1982	19	0	0	1	5	10 (1)[c]	53	4(0)	21	5(0)	26
1983	34	10[d]	29	16	47	19(10)	56	3(1)	9	13(5)	38
1984	27	3[d]	11	9	33	22 (7)	81	1(0)	4	4(2)	15

[a] Percentage of total no. of occurrences for each year.
[b] Data from 1981 are incomplete.
[c] Actions in presence of visitors are in parentheses.
[d] All attractants were whale carcasses.

Table 4. Characteristics of polar bear occurrences at Fort Prince of Wales, Cape Merry, and Sloop's Cove National Historic Parks and Sites, Manitoba, 1981-1984.

Year	No. of Occur- rences	Total No. of Bears	Mean No. of Bears Per Occurrence	Frequency of Occurrence --of Family Group-- Female/ 1 young[a]	Frequency of Occurrence --of Family Group-- Female/ 2 young	Frequency of Occurrence of Non-Family Groups 1	Frequency of Occurrence of Non-Family Groups 2[b]	Frequency of Occurrence of Non-Family Groups 3[b]
1981	12	17	1.4	3		7	2	
1982	19	21	1.1			17	2	
1933	34	64	1.9	9	4	24	2	2
1984	27	40	1.5	2	3	19	4	

[a] Young include cubs of year or older young.
[b] Number of individual bears in group.

Merry. At [1]Fort Prince of Wales, 54 of 72 occurrences resulted in observation/monitoring, while the remaining bears were deterred by passive or active methods.

Table 3 shows the annual variation in relationships between bear occurrences, presence of attractants, and presence of visitors. In 1983, 29% of the occurrences could be directly attributed to the presence of whale carcasses on beach areas of the park and sites. This year is typified by the greatest number of occurrences and the highest use of active deterrents: 38% of management actions compared to a range of 15% to 26% for the remaining years. Occurrences that took place while visitors were on the park and sites ranged form 5% to 47% of total annual occurrences with the maximum value reported in 1983, when carrion was more readily available to bears. Presence of visitors at the park or site did not appear to be closely related to the probability of visitors being present when polar bears were deterred. In 1984, 2 of 5 cases of deterrent use occurred in the presence of visitors. Although the frequency of visitor presence during occurrences was highest in 1983, only 6 of 16 cases of deterrent use took place in the presence of visitors.

Polar bear occurrences most often involved solitary bears (Table 4). A notable exception was 1983, when the presence of carrion attracted more bears and raised the mean number of bears per occurrence to 1.9 bears, compared to a range of 1.1 to 1.5 bears in other years. This increase was due primarily to a greater number of family groups being attracted to the park and sites. Thirteen sows with 1 or 2 young were recorded in 1983, compared to a range of 0 to 5 family groups in the other years. Also, in 2 occurrences in 1983, groups of 3 individuals were reported.

Deterrents were used in 33 of the 92 occurrences on record. Active deterrents were required 25 times and included use of a helicopter on 2 occasions when bears were attracted to beached whale carcasses. In those cases the attractants proved so strong that cracker shells and other scaring devices were not effective in deterring bears from the park or sites long enough to allow safe use by visitors. On 1 August 1983 a helicopter was used to frighten a sow with 2 young and a solitary bear from Fort Prince of Wales and a sow with 1 young and a solitary bear from Cape Merry. For the remaining 23 times, the active use of deterrents on 30 bears was successful and allowed safe visitation of the areas. However, on 7 August 1983, 1 individual bear at Cape Merry demonstrated a high tolerance to presence of humans and deterrents. It was frightened from the site 4 times in 1 day, and each subsequent attempt required a closer approach.

DISCUSSION

The use of deterrents to modify activities of bears is developing into an important, but controversial, management tool (McCullough 1982; Stenhouse 1982, Rogers 1984). Objectives for using deterrents depend upon the nature of the particular bear problem, the type of bear-human conflict that is likely to occur, and the human use of the area in question. At the National Historic Park and Sites in the Churchill area, the Canadian Parks Service wishes to allow safe visits to educate the public about the historical resources by discouraging the natural tendency for bears to use the areas without threatening the bears' lives. The program used from 1981-1984 will be evaluated within the framework of this objective.

The high frequency of use of the park and sites by polar bears certainly emphasizes the need for an effective management program, particularly during the 1 month of mid-summer when bear use is greatest. The pattern of bear use of the park and sites from June to August indicates that staff handling the occurrences and Interpretive staff involved with visitors need to remain thoroughly alert and ready to respond with well-developed procedures detailed in a bear management plan (Leonard 1987).

The data suggest that a high level of protection is only available when Parks staff are on duty for 8 hours/day at Cape Merry and 6 hours/day at Fort Prince of Wales. Visitors travelling alone or with tour operators at these sites cannot depend on Parks for safety. At Sloop's Cove, Parks can only monitor bear activity and cannot use deterrents because of the lack of staff. Consequently, during a 24-hour period there still remains a high probability that visitors could be confronted by polar bears in dangerous situations. In addition, visitors that use the park and sites in the fall after Parks discontinues services are dependent upon their own initiative or tour operators for protection from bears. This is a concern that is beyond the scope of this analysis, but is nonetheless worthy of attention.

The variation in management actions among sites (Table 2) is influenced by the availability of staff resources and the size of the areas. At Cape Merry and Fort Prince of Wales, about the same level of safety is offered to the visitor despite the higher occurrence of bears at Eskimo Island near the fort. The inability to monitor all bears at Sloop's Cove and lack of staff to respond to occurrences lowers the level of safety for visitors, although both bear and visitor use has traditionally been relatively low at this site.

In 1983, more polar bears were present in the immediately vicinity of Churchill and they entered the Churchill dump area about a month earlier than in other years (Lunn and Stirling 1985). This factor may have contributed to the increased number of bears on the park and sites in 1983. Nonetheless, the documented availability of whale carrion also affected both the local abundance and distribution of bears on the park and sites and the resulting management actions. The increase in number of bears per occurrence, more frequent need for use of deterrents, and greater likelihood that bears and visitors will occupy the areas concurrently all increase the probability of a serious bear-human interaction. Maintenance of clean facilities and removal of carrion as soon as it is detected are of paramount importance in the success of the program.

The management actions applied during 1981-84 were successful enough to allow safe visitation of the park and sites. Deterrents were required in less than one-third of all occurrences, and active deterrents (excluding helicopter) were used 23 times. Cracker shells appeared to have a 95% success rate for deterring polar bears. These statements must be qualified to some extend. First, the bears probably return to a park or site after an unknown period of time and become involved in other occurrences. This may be a short period of a few hours or a few days. Second, when carrion was present, cracker shells were ineffective at moving bears away for a substantial period of time. Third, the degree of habituation of these bears to cracker shells is unknown, but undoubtedly must occur.

It is imperative that the results of this program are not applied directly to other polar bear populations or even other areas in the Churchill region. In mid-summer when the bears first come ashore, they are normally inactive (Knudsen 1978, Latour 1981, Lunn and Stirling 1985). As some bears become nutritionally stressed in the fall they tend to enter the town of Churchill and the dump area in search of food. In contrast, the time of peak bear activity on the park and sites is in mid-summer, when bears are likely least dangerous and more easy to deter. In addition, bears using the general area in which the park and sites are located tend to be younger bears, primarily subadult males (Lunn and Stirling 1985), which may be easier to deter than bears of other age and sex classes. The park and sites are located on capes and headlands, and it is normal behaviour for polar bears to select these areas while waiting for ice to form on Hudson Bay (Latour 1981). Therefore, forcing bears off the park or sites to other nearby loafing areas is simply a modification of normal behaviour. For these reasons, caution is merited when using the information presented in this paper in other management or biological situations.

LITERATURE CITED

KNUDSEN, B. 1978. Time budgets of polar bears (*Ursus maritimus*) on North Twin Island, James Bay, during summer. Can. J. Zool. 56:1627-1628.

LATOUR, P. B. 1981. Spatial relationships and behaviour of polar bears (*Ursus maritimus* Phipps) concentrated on land during the ice-free season of Hudson Bay. Can. J. Zool. 59:1763-1774.

LEONARD, R. D. 1987. Manitoba north national historic park and sites polar bear management plan. Unpublished Report. Canadian Parks Service. 22 pp.

LUNN, N. J., and I. STIRLING. 1985. The significance of supplemental food to polar bears during the ice-free period of Hudson Bay. Can. J. Zool. 63:2291-2297.

McCULLOUGH, D. R. 1982. Behavior, bears and humans. Wildl. Soc. Bull. 10:27-33.

ROGERS, L. L. 1984. Reactions of free-ranging black bears to Capsaicin spray repellent. Wildl. Soc. Bull. 12:59-61.

RUSSELL, R. H. 1975. The food habits of polar bears of James Bay and southwest Hudson Bay in summer and autumn. Arctic 28:117-129.

STENHOUSE, G. 1982. Bear detection and deterrent study, Cape Churchill, Manitoba, 1981. File report No. 23. NWT Dept. of Renewable Resources, Yellowknife.

STIRLING, I., C. JONKEL, P. SMITH, R. ROBERTSON, and D. CROSS. 1977. The ecology of the polar bear (*Ursus maritimus*) along the western coast of Hudson Bay. Can. Wildl. Serv. Occ. Pap. No. 33. 64 pp.

THE POLAR BEAR ALERT PROGRAM AT CHURCHILL, MANITOBA

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Abstract: The Manitoba Department of Natural Resources has undertaken an annual Polar Bear (*Ursus maritimus*) Alert Program at Churchill, Manitoba since 1969. The program was started in response to a rapid increase in numbers of bears, and resulting human-bear interactions, in the Churchill area during the late 1960's. The reason for the Churchill problems was an increased bear population. The program has of necessity continued to the present, though changes have occurred as a result of a declining resident human population, a rapidly expanding tourism industry, a better understanding of the biology and ecology of the bears, and experience learned through the program. The Alert Program currently in place is believed to be successfully meeting its objectives of ensuring the safety of people and the protection of property from damage by polar bears, and ensuring that bears are not unduly harassed or killed.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Polar bears create a positive image in the minds of many people. To some they can represent a source of income as a result of their consumptive or non-consumptive use; to others they can reflect the stability and health of a delicate and unspoiled northern ecosystem. Many consider the polar bear the monarch of the north, an animal that shows grace, beauty, strength and a certain mystique. In recognition of the status of the polar bear, a unique international agreement (International Agreement on the Conservation of Polar Bears and Their Habitat) was signed by Canada, Denmark, Norway, United States, and the Union of Soviet Socialist Republics to ensure its conservation (Stirling 1986). The polar bear's image is being enhanced as it becomes the subject of an increasing number of books, films, documentaries, and articles. Consequently there is a tendency to overlook the fact that polar bears can and have killed people, caused significant property damage, and disrupted the lifestyle of people at those locations where its range overlaps with that of humans. The town of Churchill, and its surrounding area in northeastern Manitoba, is likely the most well known of such locations (Figure 1). It is an area where both the positive and negative aspects of polar bear-human interactions are readily apparent. In an attempt to manage the situation, the Manitoba government has undertaken a Polar Bear Alert Program (prior to 1984 it was referred to as the Polar Bear Control Program, but because the program now consists of more than simply the control of bears it was renamed to reflect is broader scope). This paper reviews the development and current status of this program.

The Polar Bear Alert Program is the result of the hard work of a large number of individuals primarily employed by Manitoba's Department of Natural Resources (provincial) and Environment Canada's Canadian Wildlife Service (federal) over many years. Since my involvement with the program (1976) there are several persons who have provided valuable guidance, assistance and/or advice in its development, implementation and evaluation. These individuals include H. J. Boyle, I. R. Bukowsky, B. Chalmers, D. Chranowski, D. Cross, R. Dean, D. Jacobs, K. John, N. Lunn, M. Ramsay, R. J. Robertson, P. Rod, I. Stirling and I. Thorleifson.

BACKGROUND

Polar bears have been present in the Churchill area since historic times. European explorers, trappers, and fur traders all made note of them. Though commonly reported in writings since the first permanent structure was built in the area in 1717, polar bears did not draw much public attention until a military base was established at Fort Churchill (located 8 km east of the Churchill townsite) in 1942. Reports of bears close to Churchill and later Fort Churchill were not uncommon, but seldom were there any problems. Though it can never be shown conclusively, it is believed that native people living 220 km southeast of Churchill at York Factory and the military who regularly conducted exercises east of Churchill, were likely controlling the numbers, and perhaps behaviour, of bears. Following the abandonment of the settlement at York Factory in 1957, and a reduction in military activity and personnel in the Churchill area during the 1950's and 1960's, reports of bears in the Churchill area rapidly increased, and more bears started using the 3 garbage dumps located in the Churchill vicinity (Stirling et al. 1977).

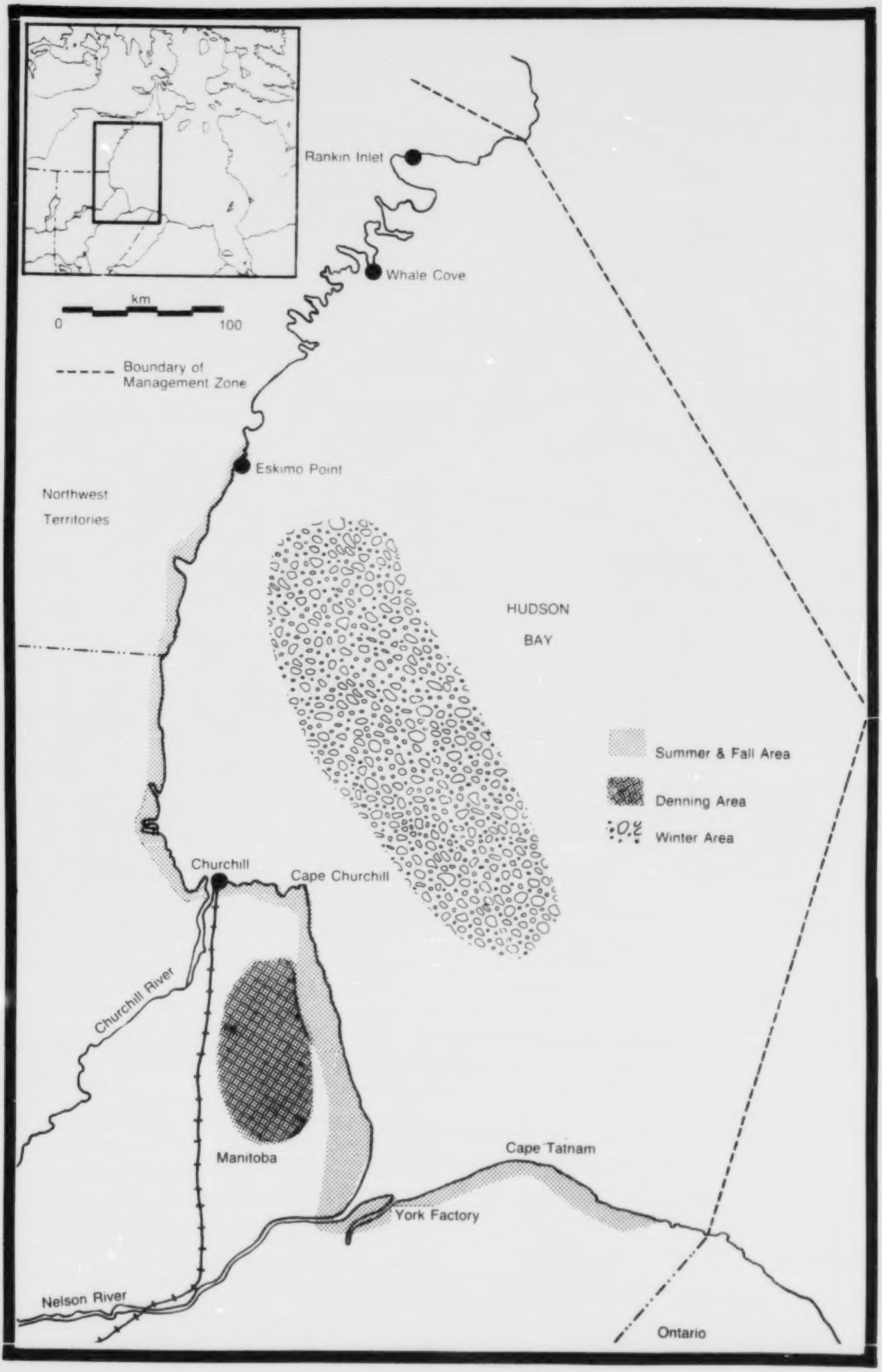
Rankin Inlet
Whale Cove
km
0
100
Boundary of Management Zone
Eskimo Point
Northwest Territories
HUDSON BAY
Summer & Fall Area
Denning Area
Winter Area
Churchill
Cape Churchill
Churchill River
Manitoba
Cape Tatnam
York Factory
Nelson River
Ontario

Figure 1. Location of Churchill, boundaries of Polar Bear Management Zone A1, and main areas used by bears in their annual movement.

Incidents between humans and bears had increased substantially by the late 1960's. In 1968, up to 40 bears at a time could be seen in the dump near Fort Churchill and an estimated 60 to 80 bears were staying in the vicinity of settled areas. Serious human-bear interactions occurred in 1963, 1966, 1967, and 1968 in the Churchill-Fort Churchill area. The 1968 incident resulted in a human death and the others in human injury. Problems with bears breaking into houses, killing dogs, and frightening people were numerous (Stirling et al. 1977).

This intolerable situation led to discussions in 1968 and 1969 between local, provincial, and federal government officials. Initially, discussions were directed at correcting the problem of garbage disposal (there were 3 dumps at this time including 1 on the immediate periphery of the townsite), but it was also recognized that a control program would be required, at least for the short term. The first organized program was started in 1969. At the same time it was recognized that little was known about the ecology of the bears in the area. An intensive research program was started to develop and evaluate management alternatives for the purpose of understanding and solving, or at least alleviating, the problems at Churchill (Stirling et al. 1977). Both programs have continued to the present. The Polar Bear Alert Program is coordinated by the Manitoba Department of Natural Resources, and the research program by the Canadian Wildlife Service.

THE PROBLEM

Churchill is a small but unique town situated at the mouth of the Churchill River. The resident population in the area has fluctuated considerably over the years and has steadily declined for the past 2 decades, though it now seems to have stabilized at approximately 1,000. The primary reasons for the decline have been the withdrawal of all military staff from Fort Churchill, the transfer of the administrative staff for the Keewatin Region of the Northwest Territories from Akudlik to Rankin Inlet, the relocation of the Churchill Indian Band from Dene Village to Tadoule Lake, and the closing of the National Research Council Rocket Range. Many of the facilities which were used by these groups of people have also been removed, though in some cases they have been taken over by other groups (Figure 2).

Though the resident population may be lower than what it was in the 1950's and 1960's, in recent years the numbers of tourists visiting Churchill have increased considerably from July through November, attracted largely by the abundance and diversity of the area's wildlife resources and habitat. The number of visitors to Churchill has been estimated at over 10,000 in some years. Though polar bears are not the only reason people travel to Churchill, they remain the major attraction and every visitor wants to see one. The tourist industry and an infrastructure dependent upon it have become a very important part of the Churchill economy and continue to grow in importance annually.

Most accounts attribute the entire problem with bears in the Churchill area to the polar bears themselves, but a lack of public awareness and understanding of the animal exaggerates the problem (Bukowsky and Kearney 1978). The attitudes of residents vary from a desire to rid the area of all bears to total acceptance of animals walking the downtown streets. Many Churchill residents are transient, residing in Churchill for a few years, and therefore only encountering bears for a short time. Their realization that they may not have many opportunities to observe or photograph a bear can cause them to take unnecessary and dangerous risks. Long-term residents, although they respect bears, can through familiarity develop a complacent attitude which may be reflected in unsatisfactory methods of garbage disposal. Children in Churchill can also be complacent in attitude, and a polar bear is often a subject of curiosity with which they do not identify potential danger. Unfortunately it seems to require a serious human-bear incident for residents to recognize or remember the dangers of polar bears, and when this occurs positions become based more on emotions than facts.

Tourists who come to Churchill specifically to see and photograph a polar bear generally are less of a problem than would be expected. They have often researched the topic, have an attitude of respect for the bears, and avoid hazardous situations. Conversely, tourists who come to Churchill to see the town and incidentally catch sight of a bear display an attitude of curiosity as opposed to respect. The increasing availability of professionally guided tours has helped to reduce the number of potentially dangerous human-bear interactions.

The annual polar bear problem in Churchill provides sensational material for the media and results in an influx of professional photographers and writers. The determination of this group to produce high quality photography and to experience close contact with the polar bears, in pursuit of a good article, makes them vulnerable to dangerous encounters. Also, the resulting film or article, though dramatic, may fail to objectively report the potentially dangerous nature of bears, or conversely, may provide an image of a town under siege by bears.

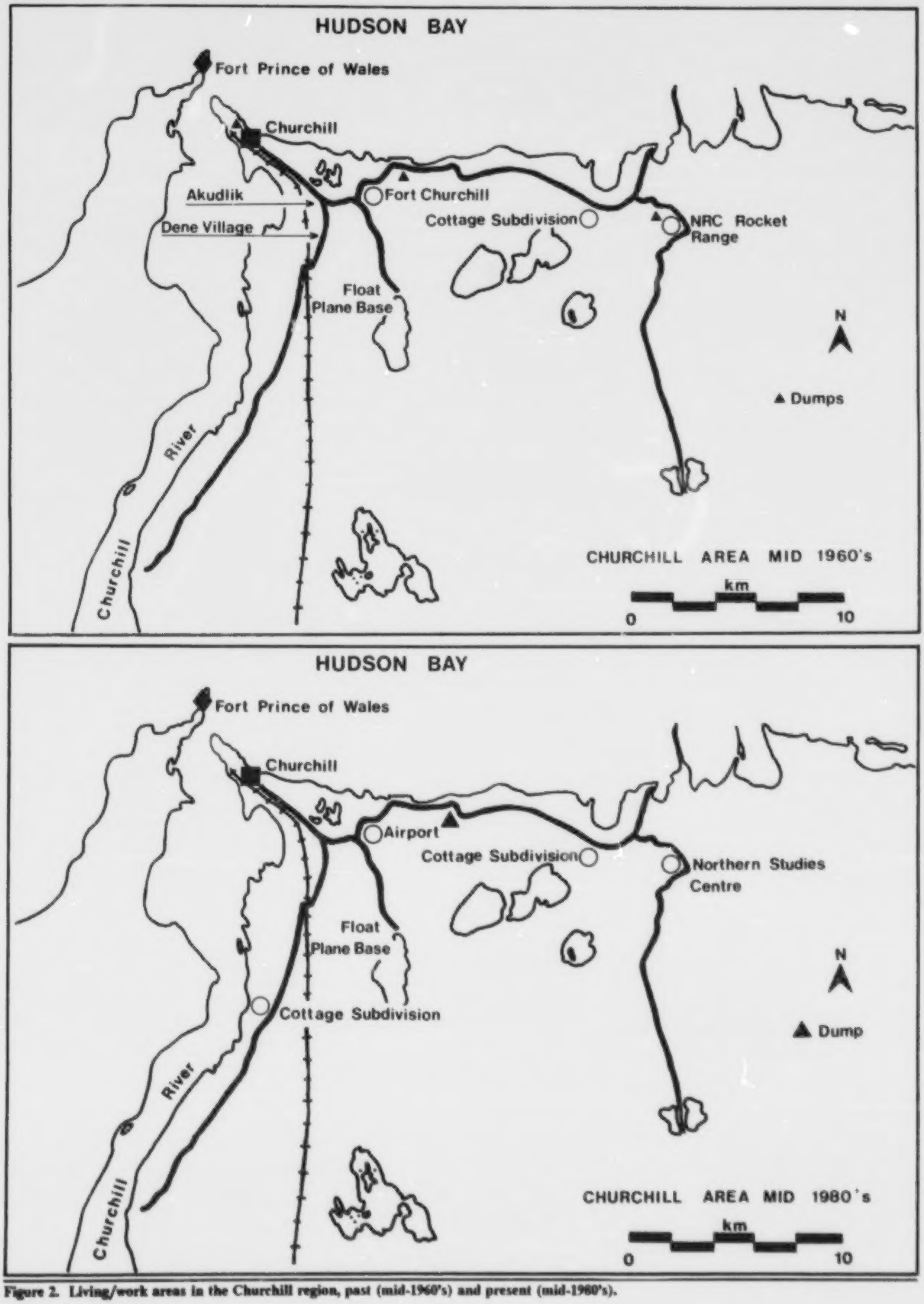
HUDSON BAY
Fort Prince of Wales
Churchill
Akudlik
Dene Village
Fort Churchill
Cottage Subdivision
NRC Rocket Range
Float Plane Base
Churchill River
N
▲ Dumps
CHURCHILL AREA MID 1960's
km
0
10
HUDSON BAY
Fort Prince of Wales
Churchill
Airport
Cottage Subdivision
Northern Studies Centre
Float Plane Base
Cottage Subdivision
Churchill River
N
▲ Dump
CHURCHILL AREA MID 1980's
km
0
10

Figure 2. Living/work areas in the Churchill region, past (mid-1960's) and present (mid-1980's).

POLAR BEAR MOVEMENTS

Since 1966, over 1,800 individual bears have been marked in the vicinity of Churchill along with several hundred more in areas to the north and south (Stirling and Ramsay 1986). These data have shown that the polar bears of the Churchill area are part of a relatively discrete subpopulation of bears for which there are reasonably well-defined boundaries (Figure 1). For management purposes, subpopulations of bears have been assigned to Polar Bear Management zones by a Federal/Provincial Polar Bear Technical Committee. Currently, there are 10 such zones in Canada. The subpopulation in the Churchill area is in Management Zone A1 (Urquhart and Schweinsburg 1984).

Of the 1,800 bears marked in Zone A1, over 400 have been marked in the accessible area around Churchill, which has allowed for a better comparison and understanding of those bears using the Churchill area relative to the entire Management Zone. Further studies concerning the reproductive biology and ecology, behaviour, on-land feeding habits, and physiology have all added to the knowledge and understanding of polar bears in this Zone. This information, where applicable, has been incorporated into the Polar Bear Alert Program.

Polar Bear Management Zone A1

The annual movements of polar bears within Management Zone A1 are relatively well understood in general terms (Figure 1), though research continues on movements of individual bears. With the exception of pregnant females that are occupying dens (the majority of which are located southeast of Churchill and 30 to 60 km inland), the entire bear population spends the winter and spring months on the ice of Hudson Bay hunting seals, its primary prey species. The females in dens give birth to cubs in late December or early January. The family groups remain in the dens until late February or March, when they move rapidly in a northeasterly direction to the bay and on to the ice (Ramsay and Andriashek 1986). From March until late July, all the bears will be on the ice and observations of animals on land at this time are rare. It was originally assumed that the bears would remain on the ice as long as possible and would then move to land when the broken ice could not support them (Stirling et al. 1977). New data indicate this may not be the case. Rather, individual animals may show fidelity to a specific area of the coast, and the timing and distribution of ice break-up may be of less significance in determining their summer distribution (Stirling and Ramsay 1986). Once ashore the animals tend to segregate by age and sex classes. Adult males are more abundant along the coast, adult females with cubs and pregnant females go inland, and subadult males occur in both areas. As the summer season progresses those bears on the coast generally move north, and most bears which earlier travelled inland move north, northeast, or east to the coast. Pregnant females remain inland to den. In fall, many bears, particularly the adult males, stage at several points of land from Cape Churchill south, apparently in anticipation of freeze-up. Up to 50 bears have been observed at Cape Churchill in the late fall, and groups of 10 to 15 bears are not uncommon at other sites. Once at these staging areas, the bears show great tolerance for one another and tend to remain at these locations until sufficient ice has formed on the Bay. This normally occurs in mid-November. Subadults and females tend to be more mobile and can be observed along the entire coast, but tend to avoid areas where adult males are concentrated. They also move on to the sea ice as soon as possible. Normally by mid-November only pregnant females remain on the land and they have entered maternity deans (Stirling et al. 1977, Latour 1981, Lunn and Stirling 1985, Stirling and Ramsay 1986).

Churchill Area

The data show that the numbers of bears in the Churchill area increase as the season progresses. Few bears are found in the Churchill area in July or August, the numbers increase in September, and reach a maximum in October and November. The bears virtually disappear from the Churchill area as soon as sufficient ice forms on Hudson Bay, which is normally mid-November. Therefore, as expected, in years of early freeze-up the number of bears and resulting problems in the Churchill area usually fewer. When freeze-up occurs later than normal, the number of animals in the Churchill area will sometimes increase.

There is considerable variation among years in numbers of bears in the Churchill area, and the reasons for this are not yet fully understood (Table 1). The date of freeze-up of Hudson Bay influences the numbers, but it does not account completely for the observed variations. Other factors such as the time of break-up of ice in the Bay, the physical condition of the bears when they move on to land, and climatic conditions during the time bears are on land could play some role in determining the numbers of bears in the Churchill area each year. Within any one year, the numbers of bears which visit the area usually represent less than 5% of the Management Zone A1 population (Stirling and Ramsay 1986).

Table 1. Number of reported occurrences of polar bears and number of bears handled in the Churchill area, 1969 to 1986.

Year	Number of Occurrences	Number of Bears Handled[a]
1969	112	29
1970	249	34
1971	227	56
1972	73	30
1973	74	24
1974	206	41
1975	184	41
1976	207	50
1977	99	32
1978	87	16
1979	102	27
1980	31	18
1981	74	27
1982	70	32
1983	210	92
1984	59	18
1985	85	76
1986	69	26
Total	2218	669

[a] Includes individual bears that have been captured in the Churchill area in more than 1 year.

The marking program has provided information on the use of the Churchill area by individual bears. Most bears which travel to the Churchill area do so only once, particularly bears that come to Churchill on their own and not accompanied by their mother. Of those bears that do return to Churchill, most do so only one more time, and normally in the first or second year following their first visit to Churchill. Cubs or yearlings taken to Churchill by their mothers, subadult males, and adult females are most often the repeat offenders. The fact that most bears only travel to the Churchill area only once or twice, and usually as subadults, could be interpreted as meaning many individuals learn at a young age to avoid the Churchill area as opposed to learning to move to the area. Likely, both situations occur depending on the individual animal.

Subadult males show a marked affinity to the Churchill area compared to other sex/age groups. Significantly more adult females than adult males have been handled in the Churchill area, and in most cases these females have been accompanied by cubs or yearlings. Females with young normally confine their activities to the dump and immediate area rather than the Churchill townsite. Though these females seldom cause problems themselves, their offspring can show a high affinity for the area once they are on their own and are often removed as problem animals at a relatively young age.

POLAR BEAR ALERT PROGRAM

Program Background

Since 1969, the Manitoba Department of Natural Resources has undertaken a fall Polar Bear Alert Program. It continued without major incident from 1969 to 1982. During this time it was reviewed regularly and revised to reflect the changing situation in Churchill, to incorporate the results of mark-recapture studies and other research, to provide for the use of new and better equipment, and to eliminate potentially hazardous situations. Other actions to reduce the bear problem were tried but were not always successful. The program functioned well, and if there was a criticism from the public it was that the Department killed too many bears. Though neither human-bear interactions nor occasional property damage were eliminated, there were no serious human-bear confrontations resulting in a human injury or death during this period. However a number of bears were killed by people defending life or property.

The 1983 problem period proved to be one of the longest and most difficult since 1969 with a record number of bears (92) being handled. There were 2 serious human-bear interactions, including 1 in downtown Churchill which resulted in a human fatality. These 2 incidents (both the result of human error), coupled with a longer-than-normal season, resulted in considerable consternation by Churchill residents about the bear situation. In August 1984, before the "normal" problem bear period had begun, another Churchill resident was severely mauled by a bear while on a fishing trip north of town. This was the final evidence required by many Churchill residents to conclude that polar bears were becoming more numerous and aggressive, and that the Department of Natural Resources must take more decisive action to alleviate the situation. At the same time a tourism industry based on bears was expanding rapidly. This resulted in a major review of all data relevant to the program, and in revisions and additions to the policy and procedures in place at the time. The revised policy and procedures have been used in the 1985 and 1986 programs.

Program Policy

The primary objective of the Program is to ensure the safety of people and the protection of property from damage by polar bears. No bears are tolerated in or within close proximity to any inhabited area in the immediate Churchill area that is accessible by the existing road system. The Churchill townsite is given priority. Other inhabited areas, including the Churchill airport, recreational areas, isolated residences/ recreational cabins, and some temporary sites, will be given priority provided the situation in and around the Churchill townsite is under control. Action can also be directed at polar bears in that area peripheral to the priority areas to reduce the potential for bears encroaching on inhabited areas.

A second objective is to ensure that polar bears are not unduly harassed or killed. This consideration has become more important in recent years as a competitive tourism industry has developed to meet the growing demand to view, photograph, and write about the bears. This objective is intended to prevent such activities from having a negative impact on the bears.

Program Considerations

In meeting its objectives the Alert Program must attempt to incorporate the attitudes and actions of the different segments of the Churchill population, both residents and non-residents, with what is known about the biology and ecology of the bear. For example, mark-recapture studies have shown that the permanent removal of all bears found in the Churchill area would have been disastrous to the polar bear population given that most individuals are only one-time offenders. The same studies have shown that the polar bears that occur in the Churchill area belong to a population that is shared with the Northwest Territories. Any bears killed or removed from the population through the Control Program must be included as part of the total quota for Zone A1.

Experience gained since 1969 has also shown that there is no way to accurately predict the length of the problem period or the degree of the problem in any year. This means that the Department cannot become complacent in the delivery of the program, particularly after several years with few problems. The public must recognize this also.

Finally, if the bear population is to be maintained at its current level, a factor of considerable importance to the success of the existing tourism industry, individual animals will likely to continue to occur annually in the Churchill area simply due to its physical location.

For the purpose of polar bear control, the Churchill region has been subdivided into 3 areas: (1) the living/work area, including the Churchill townsite and other inhabited sites and areas regularly used for work, such as the airport and its adjacent warehouses; (2) the perimeter area, including most areas accessible by the existing all-weather road system; and (3) the remote area, being that area which is inaccessible to regular vehicles (Figure 3). Specific procedures have been identified for each of these areas, with the level of control increasing from the remote area through the perimeter area to the living/work area (Table 2).

In a bear program of this nature, certain procedures, particularly new ones, can be controversial. This was true for several procedures revised or added to the program following its review in 1984. For example, the dump and its surrounding area were included as part of the living/work area. Consequently all bears would be removed from the dump. Previously, bears in the dump were only marked and no action was taken unless an animal moved to an inhabited area. This happened each year with some bears. This procedure only became feasible with the building of an indoor compound (Polar Bear Compound) in 1982 which allows the Department to hold up to 20 individuals and/or family groups in separate cages. There was concern that this action could have a negative impact on tourism, but to date this does not appear to have occurred probably in a large part due to the existing tourist operations which provide opportunities to see animals in a more natural setting than a dump.

Program Procedures

The procedures of the Polar Bear Alert Program are intended to provide for the consistent delivery of the program by staff of the Department of Natural Resources. The procedures clearly indicate the roles and responsibilities of individuals within the Department for the development, budgeting and evaluation of the program; for organizing, monitoring and evaluating the program delivery; and for reviewing and revising program guidelines as necessary. The guidelines outline staff responsibilities, equipment maintenance and use, the handling of bears (scaring, live-trapping using culvert traps and leg snares, chemical immobilization, shooting), the holding of bears in the Polar Bear Compound, handling of emergency situations (human fatalities/ maulings), Local Government District and Royal Canadian Mounted Police involvement and assistance, and data collection.

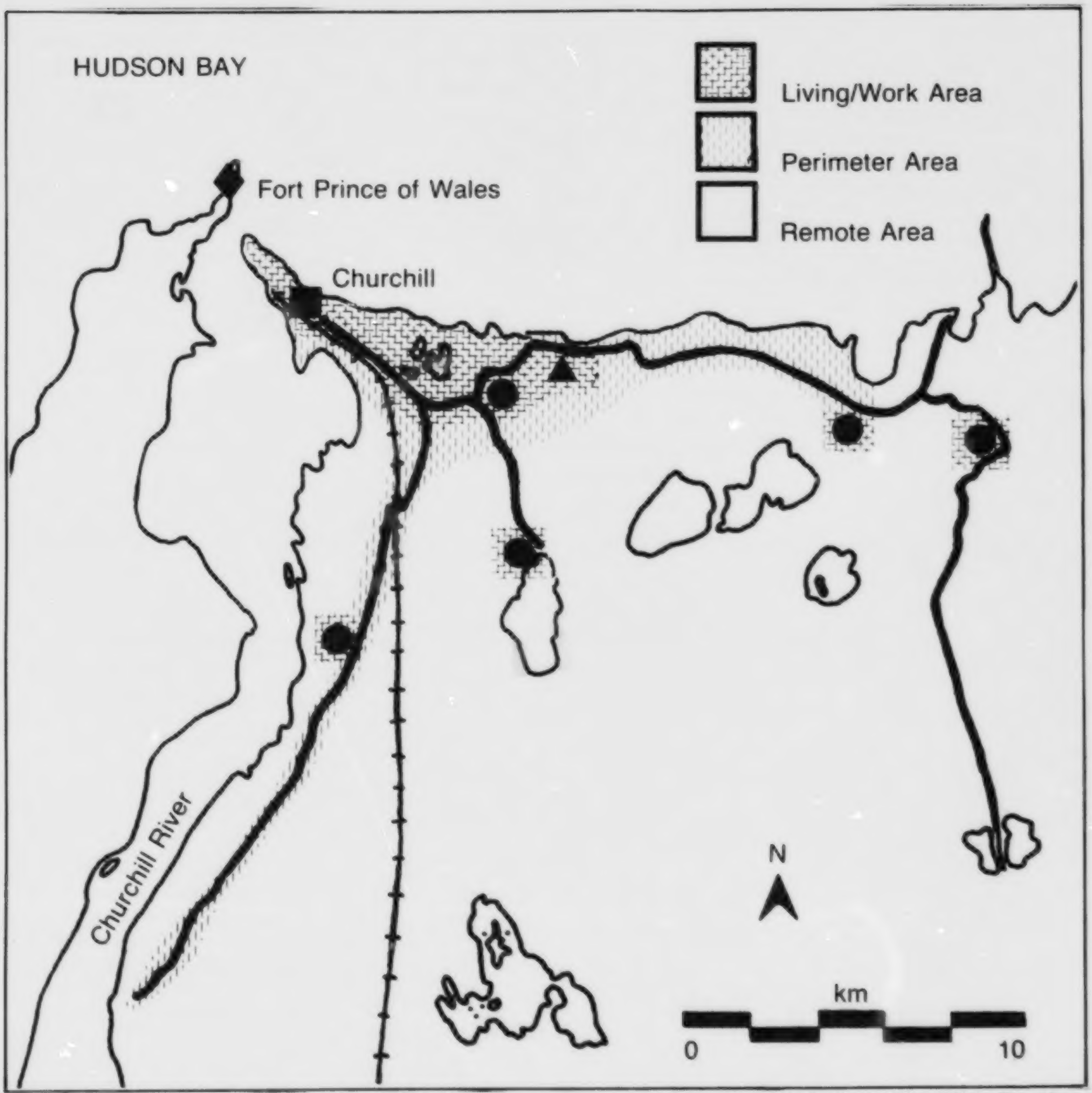
HUDSON BAY
Living/Work Area
Perimeter Area
Remote Area
Fort Prince of Wales
Churchill
Churchill River
N
km
0
10

Figure 3. Subdivision of the Churchill area into the living/work area, perimeter area and remote area for implementation of Polar Bear Alert Program procedures.

Table 2. Polar Bear Alert Program procedures directed at the living/work area, the perimeter area, and the remote area.

Procedure	Living/ Work Area	Peri-meter Area	Remote Area
Removal[a] of all bears by scaring, live-capture or shooting.	Yes	No	No
Removal[a] of all bears previously captured in the living/work or perimeter area by live-capture.	Yes	Yes	No
Removal[a] of all polar bear family groups by live-capture.	Yes	Yes	No
Permanent removal[b] from the population of those bears which have been captured in 3 or more years previously in the living/work area.	Yes	Yes	No
Regular meetings between Department staff and the Local Government District Council to inform, plan and evaluate the program.	Yes	Yes	No
Annual questionnaire to Churchill residents to assist in program evaluation	Yes	Yes	No
Enactment and/or enforcement of by-laws and regulations to minimize the sources of attractants to bears.	Yes	Yes	No
High profile signing in specific areas.	Yes	Yes	No
Public information/education program to increase the awareness of potential dangers of polar bears.	Yes	Yes	Yes
Prohibition of polar bear baiting for any purpose unless by permit.	Yes	Yes	Yes
Continued capture and marking of polar bears.	Yes	Yes	Yes

[a] All bears captured are placed in the Polar Bear Compound until Hudson Bay is frozen, or they are transported away from the Churchill area.

[b] Bears to be removed from the population permanently will be placed in zoos if possible.

The procedure of removing all family groups from the living/work area and the perimeter area as soon as possible was also added in 1984, in an attempt to prevent cubs and yearlings from becoming problem animals.

Though some bears had been sent to zoos since the program started, it was not until the most recent review that a criterion for the permanent removal of specific individuals was introduced (Table 2). Unfortunately, implementing this procedure resulted in the loss of some bears which, because of their age and frequency of returning, were providing new scientific information each year they returned. In these few cases, however, it was decided to put public safety ahead of the need for additional information, particularly given that such bears were exceptions to the "normal" bears handled in Churchill.

A regulation to prohibit the baiting of bears anywhere within 10 km of the Hudson Bay coast was also introduced with the new program. This practice had grown as the competitive nature of the tourism industry increased, but is now considered to require strict control. Introducing a large number of bears to human-food association could increase problems in the future.

In an effort to monitor the local residents' attitude toward the bears and the Alert Program, an annual questionnaire is sent to each household. The revised program seems to have been well-received by the local public based on the results of questionnaires done at the end of the 1985 and 1986 problem seasons.

CONCLUSION

A program such as the Alert Program requires a dynamic approach incorporating regular review and evaluation. Changes made in program procedures must be monitored to determine their effectiveness. Continued research efforts by the Canadian Wildlife Service and others provide new information on the biology and ecology of polar bears which must be considered. Finally, the Churchill situation continues to change and this must also be considered in the program design.

Under existing conditions, the actual and potential polar bear problems in the Churchill area will not abate without the complete abandonment of the townsite or permanent removal of large numbers of bears. Neither of these solutions is acceptable. Consequently, the annual Polar Bear Alert Program will be required to ensure the safety of people and their property and the perpetuation of a healthy polar bear population.

LITERATURE CITED

BUKOWSKY, I. R., and S. KEARNEY. 1978. Management of Manitoba's polar bears. Conservation Comment. Man. Dept. Nat. Res. 6 pp.

LATOUR, P. B. 1981. Spatial relationships and behaviour of polar bears (*Ursus maritimus*) concentrated on land during the ice-free season of Hudson Bay. Can. J. Zool. 59:1763-1774.

LUNN, N. J., and I. STIRLING. 1985. The significance of supplemental food to polar bears during the ice-free period of Hudson Bay. Can. J. Zool. 63:2291-2297.

RAMSAY, M. A., and D. S. ANDRIASHEK. 1986. Long distance route orientation of female polar bears (*Ursus maritimus*) in spring. J. Zool. Lond. (A)208:63-72.

STIRLING, I. 1986. Research and management of polar bears *Ursus maritimus*. Polar Record 23(143):167-176.

_____, C. JONKEL, P. SMITH, R. ROBERTSON, and D. CROSS. 1977. The ecology of the polar bear (*Ursus maritimus*) along the western coast of Hudson Bay. Can. Wildl. Serv. Occ. Pap. No. 33. 62 pp.

_____, and M. A. RAMSAY. 1986. Polar bears in Hudson Bay and Foxe Basin: present knowledge and research opportunities. Pages 341-354 *in* I.P. Martini, ed. Canadian Inland Seas. Elsevier Science Publishers B.V., Amsterdam.

URQUHART, D. R., and R. E. SCHWEINSBURG. 1984. Life history and known distribution of polar bear in the Northwest Territories up to 1981. NWT Dept. of Renewable Resources, Yellowknife. 70 pp.

A PROGRAM TO MINIMIZE CONFLICTS BETWEEN GRIZZLY BEARS AND PEOPLE IN BRITISH COLUMBIA PROVINCIAL PARKS

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Abstract: Many provincial parks in British Columbia contain important populations of grizzly bears (*Ursus arctos horribilis*). A review of the current bear management activities in B.C. Parks, and in other agencies and jurisdictions, has resulted in a comprehensive bear management program. The recommended program incorporates 3 Bear Policies, 17 Management Directives, and 2 levels of Grizzly Bear-People Management Plans. Use of the program will safeguard preservation of grizzly bears and maximize visitor safety in parks.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

A study of grizzly bear preservation and management in British Columbia Provincial Parks was conducted for the B.C. Park Programs Branch (B.C. Parks) between July 1986 and March 1987 (McCrory and Herrero 1987). Detailed information on the importance of the B.C. Park system to preservation of the grizzly bear in a regional to international context will be published separately. This paper focuses on a comprehensive strategy to minimize human-grizzly conflicts and preserve grizzly bears in B.C. Parks.

We thank numerous personnel within B.C. Parks and other North American park/wilderness management agencies for providing background information and numerous suggestions.

STUDY AREA

The study area included the entire province of British Columbia (93,049,668 ha), with special emphasis on the 53 larger provincial park areas (over 1,000 ha) within the past and present range of the grizzly bear, and 89 smaller parks (under 1,000 ha) where grizzly bears occur. The 53 larger parks comprise approximately 4,402,700 ha or 4.7% of the provincial land base. The B.C. Provincial Park system uses 2 major park designations: Class A parks, which offer the highest protection; and recreation areas, which allow some industrial activities such as mining. The B.C. Park system also includes the Purcell Wilderness Conservancy.

The B.C. Park system encompasses the greatest diversity of grizzly bear habitats of any park system in North America. B.C. Parks also administers the second largest protected land area and the highest number of parks in grizzly bear range in Canada. While B.C. Parks has legislated management jurisdiction over grizzly bears in provincial parks, most aspects of management are done in cooperation with the B.C. Wildlife Branch. Additional information on physiography and vegetation of the 52 distinct regional landscapes and 7 marine environments that occur in British Columbia is provided in a separate study (B.C. Provincial Parks 1982).

The provincial park system has a high value in the context of regional, provincial, national, and international preservation of the grizzly bear. The parks over 1,000 ha include an estimated total of about 390 grizzly bears, or 6% of the 6,600 grizzly bears in B.C. Population reductions or extirpations have occurred in about 10% of the total area of grizzly bear range protected by the larger provincial parks.

Presently, hunting of grizzly bears is allowed in 20 of the provincial park areas which are over 1,000 ha in size. B.C. Parks policy is to maintain conservative harvest levels in each park where hunting is allowed, to protect the hunted populations.

METHODS

We interviewed 40 B.C. Parks headquarters and regional personnel to determine their views and needs concerning bear management in parks. We conducted the interviews informally on an individual or group basis.

We then reviewed B.C. Parks' background documents related to grizzly bear-people management involving the following components: overall program, policies and directives/guidelines, monitoring, public communication, and planning. Some comparison was made to grizzly bear-people management strategies used by the following 9 North American parks/wilderness agencies:

- B.C. Wildlife Branch
- Alaska Division of Parks
- Yukon Lands, Parks and Resources
- Northwest Territories Renewable Resources
- Alberta Provincial Parks
- Parks Canada
- U.S. National Park Service
- U.S. Interagency Grizzly Bear Committee
- U.S. Department of Agriculture, Forest Service

We made an evaluation of the progressive and deficient aspects of grizzly bear-people management within B.C. Parks. Using this information, the results of staff interviews, and the most progressive approaches used by other management agencies in North America, we designed a comprehensive program for grizzly bear-people management by B.C. Parks.

RESULTS AND DISCUSSION

Evaluation from Staff Interviews

Interviews with 40 B.C. Parks personnel indicated that they had taken many positive measures to minimize grizzly bear-people conflicts. Such measures included management of food and garbage, public communications, monitoring of bear data, problem bear control, and some planning to avoid the placement of recreational facilities in prime grizzly bear habitats. However, staff members pointed out that these positive measures were sometimes inadequate or were only applied on a sporadic basis through the B.C. Park system. Collectively, they felt that management of grizzlies in parks would be improved by incorporating the following into the program: identification of the importance of preservation of the grizzly bear; comprehensive policies and management directives; coordinated ecological system management around parks; population monitoring; guidelines to deal with problem bears, bear attacks, and carrion; public viewing of grizzly bears; staff training; and bear research. Therefore, while staff identified some success in grizzly management, it was generally felt that improvements were required.

Review of B.C. Parks' Grizzly Bear-People Management Program

Overall Program

Grizzly bear management in B.C. Parks has evolved without an organized program directed from headquarters. Further development of bear management in parks will require such program direction to be effective.

Policies

B.C. Parks has 5 general policies which staff apply to grizzly bear-people management: System Policy (1985), Park Land Designation Policy (1985), Resource Management Policy (1986), Park Master Plan Policy (1984), and Wildlife Management in Park Act Land Designations Policy (1984). However, there is no clear statement describing how these general policies should be applied to grizzly bear management. For example, the System Policy (1985) points out that facility developments and their impacts are concentrated in relatively small areas, while about "85% of the park system land base is managed primarily free of man". This could be interpreted to mean that the impacts of facility developments on grizzly bears could be confined to the sites. However, facilities that are located in prime grizzly bear habitats may potentially have serious impacts on bear populations over large areas. One documented example is the Fishing Bridge Development in Yellowstone National Park, which contributed to a decline in the grizzly population over substantial portions of the Park (U.S. National Park Service 1984).

Grizzly Bear Monitoring

B.C. Parks has a province-wide monitoring system to document complaints about bears. This system does not record important information such as species, age, or sex of the bear involved. However, staff in Kokanee Glacier Park devised a more detailed monitoring system including documentation of grizzly bear sightings, sex and age, behaviour and activities, and bear-people encounters. Although staff in B.C. Parks' regions monitor the annual kill of grizzlies in parks where hunting is allowed, they do not monitor population trends and total annual known mortality in and around provincial parks. Thus the status of park grizzly populations is relatively unknown.

Public Communication

B.C. Parks' province-wide public communication program about grizzly bears was limited to 1 brochure produced in 1982. At the park level, some brochures provide informative facts and warnings about grizzly bears to the public. As well, some park interpretive programs include information on grizzly bears. However, B.C. Parks has not been using other opportunities available to inform the public about grizzly bears. For example, the "British Columbia Road Map and Parks Guide to Supernatural British Columbia" does not mention that grizzly bears occur in numerous provincial parks. While similar map-brochures for the Regions do mention grizzly bears, they do not identify parks having grizzly bear hazards, and do not provide other information that would be useful to park visitors. Some park brochures do not inform the public of known grizzly bear hazards and seasonal closure of trails required because of grizzly bear concentrations. In addition, major nature centres do not provide displays on grizzly bear ecology and public safety. As well, no sites have been identified in provincial parks for the public to safely observe and photograph grizzly bears.

The consequence of an incomplete public information system on grizzly bears is that critical opportunities are lost to educate thousands of park visitors about the general ecology, preservation values, and safety concerns related to grizzly bears.

Public education not only reduces potential grizzly bear-people conflicts but also ensures that the agency responsible has met its obligations in terms of public liability. Most litigation undertaken by victims of bear maulings against Parks Canada and the U.S. National Park Service has been based on the claim that the agency involved did not provide sufficient warning of the hazards of grizzly bears (Taylor 1984).

Planning

Five aspects of B.C. Parks planning were reviewed with respect to grizzly bear management.

System Planning • System planning is used to systematically plan for additions or deletions to the park system, and to designate park status. A review of System planning revealed that important concerns, such as the need to represent large ecological systems of the province, were not being implemented, even though this is implicit in the goals of the 1985 System Policy. For example, the central plateau of B.C.'s largest park, Tweedsmuir (980,000 ha), was considered for deletion because it was not integral to the high wilderness values of the park. However, this suggestion did not consider that the central plateau has significant grizzly bear habitats and that it would be essential to maintaining a large contiguous ecological system for grizzly bears. After review, the central plateau was retained in the park because of the wildlife values.

Park Master Plans • There is an increasing trend to develop provincial parks to facilitate visitor use and attract tourism revenue to the province. Master Planning is used to set park goals, to zone areas for visitor use and wilderness, and to ensure that developments do not erode the conservation values of the parks.

As background, we reviewed recent master plans for 5 provincial parks representing a diversity of grizzly bear habitats and wilderness-people situations. Of these, 3 master plans incorporated an adequate level of information on grizzly bears into park goals, zoning, and planning of recreational facilities to avoid important grizzly bear habitats. Serious deficiencies were identified in 2 master plans which propose a wide spectrum of increased recreational development in association with tourist marketing strategies. These plans make few or no provisions to carefully locate developments to avoid important grizzly bear habitats. If such developments were allowed to proceed without planning they could cause serious conflicts between people and grizzly bears.

Grizzly Bear-People Management Plan • A specific bear-people management plan has so far been prepared for 1 park district in the province. Similar plans should be prepared for other districts or parks which have substantial grizzly bear populations and where increased recreational developments are proposed.

Small Parks Planning • At least 89 smaller parks (under 1000 ha in size) are located where grizzly bears occur. To date, B.C. Parks has no bear management guidelines concerning selection and development of smaller parks. However, it has started to plan for management of individual small parks. Recently, B.C. Parks applied careful planning and management principles to minimize grizzly bear-people conflicts at the Meziadin Lake campground constructed approx-imately 0.5 km from a stream where grizzly bears concentrate to feed on spawning salmon. The camp- site was built in the area to control the previously unregulated public use of the site. It was impossible to prevent public use of the spot, and it was decided that controlled use was better than unmanaged use.

Recreation Area Planning • The current policy is to designate new additions to the B.C. Park system as recreation areas, as well as to apply this status to portions of existing Class A parks having commitments to mineral interests. The policy is to convert these recreation areas to Class A park status when the legal mineral tenures are extinguished. The activities associated with mineral development have the potential to affect grizzly bear populations and to create human-grizzly conflicts. Presently, B.C. Parks has no formal guidelines to minimize the effects of mineral development on grizzlies.

PROPOSED B.C. PARKS GRIZZLY BEAR-PEOPLE MANAGEMENT PROGRAM

The results of our study indicated that the current B.C. Parks management program is inadequate to protect grizzly bear populations, and to maximize visitor safety, as visitor use and facility development escalate in parks and recreation areas, and as mineral development proceeds in recreation areas. An improved program of grizzly-people management will be essential to prevent or solve future grizzly management problems resulting from increased human activity. Evaluation of the collective views of B.C. Parks staff showed that there is good support for a comprehensive program of managing grizzlies in parks and recreation areas.

Suggestions from interviews with B.C. Parks staff were integrated with our background review of management approaches used by B.C. Parks and other North American park/wilderness agencies to formulate an up-to-date program. Much of our recommended program was based on Taylor's 1984 comprehensive review of North American bear management plans and the new bear management plan for Kootenay National Park, B.C. (Anon. *a* 1986), which was largely based on Taylor's work.

The proposed program consists of 3 different but interconnected levels: policies, management directives and guidelines, and grizzly bear-people management plans.

Policies

Policies provide the overall objectives and principles. The following 3 proposed grizzly bear policies were designated to be used in conjunction with the 5 existing general policies.

Preservation Policy • This policy would emphasize the importance of provincial parks to the preservation of the grizzly bear, and state why the grizzly bear should be given the highest management priority of any species except legally designated threatened or endangered species.

Visitor Appreciation Policy • This policy would state that B.C. Parks will provide opportunities for visitor appreciation of the grizzly bear as a world-class resource.

Public Safety Policy • This policy would state that B.C. Parks will maximize public safety by minimizing grizzly bear-human conflicts through a comprehensive management program. It was suggested this policy be modelled after the Glacier Park, Montana bear policy (Anon. *b* 1986).

Management Directives and Guidelines

Seventeen proposed directives connect the bear policies to the specific day-to-day operations at the various levels of bureaucracy. In some instances, such as master planning, guidelines would be necessary to interpret and apply the directives.

Program Objectives • The program objectives should summarize the 3 grizzly bear policies and should also set specific and measurable goals to be met over a fixed time period in each park. For example, the goals might be to achieve a minimal rate of grizzly-human encounters, and a certain grizzly bear population size, over a 5-year period.

Organizational Structure • The directive for organizational structure should specify that cooperation within B.C. Parks is required for a successful program. This directive should also indicate the responsibilities of the various sections within B.C. Parks in the management of grizzly bears.

Program Evaluation • This objective should state that the success of the program will be evaluated at regular intervals to determine if the specific objectives have been met.

Grizzly Bear Preservation • This directive should state the importance of the B.C. Park system to preservation of the grizzly bear in B.C., and should instruct that the protection of grizzly populations is the first priority in park management activities that affect bears.

Interagency Cooperation • This directive should specify that cooperation between B.C. Parks and other agencies is essential for a successful program. This directive should also outline the responsibilities of the various agencies for grizzly management within parks.

Coordinated Ecological System Management • This directive should state the importance of coordinated management of bear populations that range over park and non-park jurisdictions. It should also state B.C. Parks' intent to participate in coordinated management around parks, and should include guidelines for identifying and managing the areas requiring coordinated management.

Planning • The planning directive should state that adequate information on grizzly bear populations, habitats, hazards, and preservation values must be incorporated at every level of park planning. To strengthen this directive, guidelines should be included to facilitate use of grizzly bear information in overall park system planning, master planning for small and large parks, recreational facility design and site plans, and planning of industrial activities in lands designated as recreation areas.

Monitoring • The monitoring directive should state that a standardized bear-people monitoring system will be implemented to record sightings of bears, encounters with bears, garbage problems, number of trail users, known bear mortalities, and other relevant information where necessary for management purposes.

Public Communication • The public communication directive should state that B.C. Parks will inform park visitors about the hazards of visiting grizzly country, and about the methods for minimizing hazards, to maximize their safety. This directive should also state that the public will be informed about grizzly bears to enhance their appreciation of the need to preserve grizzlies, and of the role of parks in grizzly preservation.

Public Viewing of Grizzly Bears • The viewing directive should state the valuable role of viewing of grizzlies in increasing the public's concern for grizzly preservation. The directive should state that B.C. Parks will identify potential sites to develop for viewing of grizzlies, and that careful planning will be required to maintain visitor safety.

Unnatural Food and Garbage Management • This directive should outline the importance of preventing the habituation of grizzlies to unnatural food sources. The directive should also outline the management procedures that B.C. Parks will use to minimize the availability of human food and garbage, fish offal, or unnatural carrion, to grizzlies.

Problem Bear Management • The problem bear directive should state that interagency cooperation is essential to deal with problem bears quickly, safely, and humanely. The directive should outline the roles of the relevant agencies, and should also provide guidelines and criteria for the capture, relocation, or destruction of problem animals.

Emergency Planning - Bear Attacks • This directive should state that B.C. Parks will be adequately prepared to deal promptly with bear attacks on park visitors. Preparation should include staff training, prearranged cooperation with the Wildlife Branch and Conservation Officer Service, a hotline to bear experts, and a well-trained provincial emergency team.

Visitor Management • This directive should state that the management of visitor activity is essential to minimize conflicts between grizzly bears and people. The directive should indicate that the timing, location, and amount of visitor use in grizzly habitats will be managed to minimize the potential for conflicts with the bears.

Staff Training • The training directive should state the type of training that various parks staff will receive in the biology of grizzly bears, and in the methods for minimizing and handling human-bear conflicts. The directive should also include a timetable for the required staff training.

Research • The research directive should outline the commitment of B.C. Parks to initiate or participate in research projects on grizzlies in parks to provide the information needed for sound management of bears.

Law Enforcement • The enforcement directive should indicate the types of regulations that B.C. Parks will use to control visitor activity and unnatural food sources in parks. The directive should also include a timetable for enacting the required regulations, as well as the procedures for enforcement.

Grizzly Bear-People Management Plans

Detailed, action oriented, grizzly-people management plans are required to ensure that grizzly populations in parks are adequately protected, and to maximize visitor safety in parks. The topics in the 17 program directives should form the elements of these management plans.

Although there are currently bear management plans for many large North American national parks in grizzly bear country (Taylor 1984), we felt that park-specific plans were not appropriate for B.C. Parks. Provincial parks in B.C. are divided among a number of districts, and each district includes a diversity of small and large parks having grizzly bears. The most effective plans would cover all of the parks within each district. Such district plans would be the easiest for the district staff to implement. While the district plans are the most important, operational plans should be prepared for specific parks having exceptional grizzly populations or concerns for human safety.

While all of the elements of the overall program are important, success in preserving grizzly bears and minimizing conflict will ultimately depend on wise preparation and implementation of the management plans.

LITERATURE CITED

ANONYMOUS *a*. 1986. Draft bear management plan, Kootenay National Park 1985-1989. Year I, 1985. Warden Service. 21 pp. + appendices.

_____ *b*. 1986. Bear management plan and guidelines. Glacier National Park, Mont. National Park Service.

B.C. PROVINCIAL PARKS. 1982. Natural regions and regional landscapes for British Columbia's Provincial Park System. B.C. Parks and Outdoor Recreation Division. 127 pp.

McCRORY, W. P., and S. HERRERO. 1987. Preservation and management of the grizzly bear in B.C. provincial parks. The urgent challenge. Report to B.C. Parks and Outdoor Recreation Division, Victoria, B.C. 185 pp.

TAYLOR, J. S. 1984. Bear management plans in Canadian national parks: fifteen essential elements. M.S. Thesis. Univ. of Calgary, Calgary, Alberta. 347 pp.

U.S. NATIONAL PARK SERVICE. 1984. Fishing Bridge and the Yellowstone ecosystem. A report to the director. November, 1984. 151 pp.

GRIZZLY BEAR MANAGEMENT CONCERNS ASSOCIATED WITH A NORTHERN MINING TOWN GARBAGE DUMP

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Abstract: Faro, a typical northern Canadian mining town in Yukon, evolved in the absence of any controls and planning efforts addressing solid waste management and wildlife concerns. As a result, garbage was dumped within 750 m of the town without any consideration for the potential effects on bear populations and human safety. This poor refuse disposal system created 9 identifiable grizzly bear (*Ursus arctos*) management problems: (1) property damage, (2) threat to human safety, (3) increased poaching, (4) lethal removal of "problem" bears, (5) reduced commercial hunting opportunities, (6) increased cost of problem bear management, (7) susceptibility to litigation, (8) physical injuries and deteriorated health of bears, and (9) poor public attitudes. These problems were revealed through numerous occurrence reports submitted to the government, 3 seasons of observations at the dump, 1 year of marking and radio-tracking bears, and interviews with local residents. The collected information indicated that dump-frequenting grizzly bears were often seen around the town perimeter and occasionally entering the residential areas. Some bears damaged garbage storage facilities within the town. As well, examples of specific occurrences included one marked bear causing $12,000 damage to several outfitter camps while searching for food, a cyclist being chased and having his bicycle damaged by a marauding bear, and the destruction of a marked bear attempting to approach an occupied trapping camp after deterrent attempts failed.

Inadequacies in present refuse management practices need to be remedied. Legislative changes to compel the mining industry to address current deficiencies in refuse control must be initiated. In addition, major efforts must be made to use new technologies in developing efficient and inexpensive community garbage systems that eliminate the problem of garbage availability to bears.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Most new towns in Canada's north support mineral or petroleum extraction activities, and are small "islands" of development within vast wilderness expanses. Such communities are unlike similar support communities within parks (Taylor 1984), as there are generally few regulatory constraints on their design to protect the natural environment. This lack of proper control leads to poor solid waste management that attracts and has serious impacts on wildlife. The purpose of this paper is (1) to document the serious grizzly bear and community management problems that can develop in the absence of adequate planning for refuse management, using the mining town of Faro as an example; and (2) to emphasize the need for northern community designs that eliminate the availability of human garbage to bears.

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METHODS

The history of garbage management in Faro was determined through examination of town planning reports (Thompson et al. 1967, 1968; Makale and Kyllo Planning Assoc. Ltd. 1981) and several Town of Faro annual reports, and through interviews with long-time residents and territorial and federal employees. Patterns of human and bear use of the garbage dump and volumes of garbage at the dump were determined through twice-weekly, evening observations from 1 June to 15 September in 1979 and 1984. This was supplemented with observations made by reliable town residents, officers of the Royal Canadian Mounted Police, and Fish and Wildlife Branch personnel. All records of problem bears in Faro and vicinity were examined; however, not all problems were reported or recorded. These records were supplemented with interviews with Faro by-law enforcement and town maintenance staff, previous R.C.M.P. and Conservation

Officers, and individuals involved with bear problems. Clearly, our data underestimate actual bear problems. In 1984, 5 grizzly bears were captured at the garbage dump: all were marked and 1 adult male was fitted with a radio collar. This bear was located 30 times between 24 July and 18 September 1984 (Lindsey and Smith 1985).

RESULTS AND DISCUSSION

The Town and its Garbage

Faro is located in south central Yukon, approximately 350 km northeast of Whitehorse by road. The town was constructed in 1968 to support a large lead-silver mine nearby, and it eventually grew to become Yukon's second largest community with a population of 2,200 residents in 1981. Homes and service facilities were built within a recently burned forest on a south-facing slope 200 m above the Pelly River. Since 1973, solid wastes from both domestic and commercial sources, including the camp cafeteria, have been deposited on the floor of a natural depression 30 m deep by 100 m in diameter, 750 m west of the town and 1500 m from the town centre. A road, a small creek, and a gully are the only features which separate the dump from the town.

Although access to the dump was unrestricted, garbage was usually deposited during normal business hours. Occasionally, refuse was piled and burned, but that practice was highly variable and depended on fire hazard, manpower constraints, and the willingness of municipal staff to engage in such activities. In 1979, on a typical summer evening ($n = 22$ evenings, 8 May - 23 August), the volume of organic food waste averaged 0.86 m^3. This available garbage has attracted, in order of abundance, mew gulls (*Larus canus*), herring gulls (*L. argentatus*), ravens (*Corvus corax*), grizzly bears, wolves (*Canis lupus*), and red foxes (*Vulpes vulpes*). Prior to 1973, black bears (*Ursus americanus*) were the most numerous bear species attending the dump. As many as 30 black bears were reported feeding at the dump at the same time (Lindsey and Smith 1985). During 1974, grizzly bears began frequenting the dump, and within a few years there were virtually no black bears present.

On most rain-free summer evenings, the site resembled an amphitheatre as bears descended into the "arena" through brush on the south side, and Faro residents watched from beside vehicles parked on the access road along the perimeter of the pit. Viewers usually arrived between 0200 and 0100 hours during the summer, often bringing garbage with them to deposit near the refuse pile before parking their vehicles. As many as 32 people were observed watching the bears. In addition, visitors to Faro were often encouraged by the local information centre to visit the dump in hopes of viewing and photographing the grizzly bears.

Grizzly Bear Management Concerns

Nine types of grizzly bear management concerns associated with Faro's garbage dump were observed, and are outlined below.

Property Damage • Food-conditioned bears feeding at the Faro dump caused local and regional property damage. Between 1983 and 1986 there were 3 local complaints of damage to property caused by bears in Faro. Most of these involved damage to garbage storage facilities. Property damage in outlying areas resulting from bear activity was also evident. This damage was previously attributed to bears that did not frequent the Faro dump. However, after the implementation of a marking program in 1984 at Faro, it was found that most incidents of damage in the area were caused by marked "Faro" bears. One of these marked bears was killed while causing $12,000 damage to buildings in 3 outfitting camps 50-60 km north of Faro. Bear-caused damage to other outfitting camps in Yukon is not common.

Regional property damage caused by habituated and food-conditioned "Faro" bears was previously underestimated, due to difficulties in identifying the source of the habituated bears responsible for the damage. It appears that food-conditioned bears were primarily responsible for the majority of local and regional bear-caused property damage in the Faro area. This is consistent with observations made by Herrero (1985) who indicated that a disproportionately high percentage of bear-caused property damage was caused by bears habituated to garbage.

Threat to Human Safety • Habituated bears threatened human safety in Faro and the surrounding district. In 1983, a very dangerous bear-human interaction occurred when a cyclist, 10 km from Faro, was chased by a grizzly bear until the bear was deterred by a passing motorist. The bicycle was damaged by the bear after the rider escaped into the car. This type of incident has never been reported elsewhere in Yukon. There were also numerous close encounters and bluff charges associated with people coming into close contact with bears at the dump. As bears could be approached within 10 m, many people attempted to acquire close-up pictures without the protection of a vehicle. Bears often exhibited aggressive behaviours, such as bluff charges, snapping jaws, and frontal stares when approached at close range.

Threatening encounters were also exhibited by the same bears well away from the dump. This was only determined after the marking program in 1984 allowed the positive identification of Faro bears. For example, the bear that caused property damage at the outfitting camps had been habituated to garbage at Faro before trying to enter a cabin occupied by a guide and his barking dog. Another Faro-marked bear was killed in early May 1985 when it approached for the third time, and would not leave, a trapping camp located 100 km east of Faro. We suspect the only reason a serious bear-caused human injury did not occur in the Faro area was due to intensive local removal of bears and the "luck" of the individuals involved.

The residents of the Faro area were concerned about their safety because of the incidents, and because of the abundance of bears. Adult residents interviewed in 1984 avoided walking near or outside the town perimeter, and confined children to the town, due to an expressed concern about bears. Numerous bear tracks and scats were observed along fire-breaks and trails surrounding Faro in 1984. In addition, grizzly bears were observed in the residential area of the townsite an average of 6 times each summer between 1979 and 1986 (B. McKay, pers. commun.).

Poaching • Concentrations of bears at the dump provided incentives for poaching. Other incentives included the close proximity of the dump to the town, the ease of access to the dump, the high proportion of large adult grizzly bears (as many as 13 at one time), the absence of a local conservation officer, the high value of a grizzly bear pelt, and the difficulty in acquiring a legitimate kill.

Hunting or discharging a firearm was prohibited at the dumpsite by legislation under both the *Wildlife Act* and city by-laws. However, this legislation was difficult to enforce. Evidence for poaching near the dump included carcasses found without pelts, tree stands overlooking bear trails, blood stains at the dumpsite, and reports from various informants. Although it was believed that poaching was frequent, the ease of approaching, killing, and transporting a grizzly bear from the dump prevented reliable estimates of the number of illegally taken bears. Two main problems resulted from the poaching: (1) the effect of illegal kills on the population was not known; and (2) bears killed at the dump were likely reported as legal harvests from other localities.

Lethal Removal of Problem Bears • Lethal removal was the only technique used to control potential problems created by habituated bears near Faro. Between 1980 and 1986, there were 6 control kills of grizzly bears that frequented the dump. Three of the bears were shot within the town and the remaining 3 were shot in outlying areas. Alternative options to lethal control were not very viable. The circumstances necessitated an immediate response as there was rarely enough time, manpower, and expertise available to relocate bears or use deterrent or aversive conditioning methods. Even if used, it is doubtful whether these alternative measures would have been effective. For example, a marked "Faro" bear was relocated 80 air kilometres southeast of Faro in 1984, and returned within 2 days after release. Aversive conditioning techniques (e.g., rubber bullets, flares, noise) would also likely have failed as they have shown very limited success on food-conditioned bears (Herrero 1985).

Besides the obvious negative impacts on the regional grizzly bear population, lethal removal had one other major drawback. Of the 6 control kills, 4 were conducted by people who had virtually no training in problem bear management or methods of lethal control. This inexperience resulted in 2 wounded bears within the townsite - a very hazardous situation. The bears were later destroyed, and fortunately no human injury or property damage occurred. Clearly, only experienced personnel must initiate lethal control, to prevent such dangerous situations.

Reduced Hunting Opportunities • Localized removal of bears by lethal control, poaching, and hunting near the Faro dump reduced potential hunting opportunities for adjacent guide outfitters. Outfitters are allocated the portion of the estimated sustainable yield remaining after resident and control kills. Any increase in control kills reduces the number of bears available to outfitters. In Faro, there have been 8 *known* kills in the 5 most recent years which have, in effect, absorbed all sustainable yields within a 2,400 km^2 area. Consequently, 2 nearby outfitters had harvest quotas over this period reduced by 8 bears, resulting in a potential loss of approximately $9,600 per year to the outfitting industry.

Resident hunters have recently focused their attention on the Faro area because of the perceived larger size of many of the adult bears. For example, one male captured in October 1984 weighed 420 kg. The increase in resident hunting further decreased the number of bears available to the outfitting industry.

As the grizzly bear is a cornerstone in Yukon's $4 million big game outfitting industry, and the bears are highly prized trophies, a reduction in control kills is important to increase the number of bears available to the industry. In addition, resident hunters may be spared an intensively regulated hunting system (e.g., draws, permits, time restrictions) if fewer bears are destroyed as a result of habituation and food-conditioning.

Costly Management • The bear problems at Faro were expensive to manage. Between 1979 and 1986 the Yukon Fish and Wildlife Branch spent $11,900 on problem bear management in Faro. This included 2 contracts to monitor bear activities at the dump; the 1984 capture, marking, and public education program; and salary and transport costs necessary for conservation officers to handle nuisance bears and complaints. The funds and effort spent in 1984 in Faro by the Fish and Wildlife Branch to promote improvements in garbage management and safe behaviour around bears have not significantly increased public safety, reduced bear management costs, or reduced bear mortality.

Litigation Risk • The threat of litigation was high due to the well-documented hazard to public safety and the absence of measures to warn and protect the public. In both Canadian and American case law involving bear maulings, court rulings indicated that the responsible management agency was under a duty to warn the public of any known bear threats (Taylor 1984). The courts further indicated that the responsible agency was under obligation to take reasonable actions to minimize the hazards associated with bears. Failure to comply with these rulings has resulted in major financial settlements in favour of victims.

At present, in order to minimize their liability, most park agencies have instituted the use of warning signs, pamphlets, and bear-proof garbage facilities. Numerous agencies go far beyond these minimal measures. Faro has no warning signs or restrictions on access to the dump. Refuse remains easily available to foraging bears within the town and at the dumpsite. The only measure used to reduce the hazards associated with the habituated and food-conditioned bears at Faro has been the lethal control of bears entering the townsite. As a result, very few recommendations of relevant court rulings have been met in the Faro area, and litigation remains a very real concern if a mauling occurs.

Bear Health • The garbage diet has had some negative impacts on individual bears that frequented the dump. Physical injuries were sustained from broken glass and sharp objects. In one instance, a young male was immobilized at the dump following an incident where its tongue was severely lacerated on the lid of a can. The bear could not remove the can, and it was later removed from the bear's mouth by Yukon Fish and Wildlife Branch personnel.

All 4 adult bears captured in 1984 had cut and scarred foot pads as well as excessive tooth decay relative to bears captured or killed in more pristine settings. Dump-foraging bears were also observed consuming plastics and petroleum products (e.g. oil, grease); some petroleum products are known to cause kidney failure in polar bears (Oritsland et al. 1982). Other toxic items were likely consumed as well at Faro. These observations indicate that the garbage diet likely contributed to a deterioration in health of some bears in the Faro area.

Poor Public Attitudes • The dump fostered poor public attitudes towards bears and renewable resource management in 3 ways. First, residents expressed concern over the attempts by Yukon Fish and Wildlife Branch to reduce the viewing opportunities and the visitation of grizzly bears at the dump. For some people, watching bears was a highly entertaining spectator activity, and any attempt to eradicate this activity was severely opposed. Secondly, the behaviour of bears at the dump fostered inaccurate opinions of grizzly bears. On numerous occasions when bears were pawing through the smouldering garbage, their fur began to burn. They ingested garbage bags and other inedible items. They moved away very slowly when approached by visitors, and even during rock throwing episodes bears would not exhibit any significant response. All of those observations contributed to the opinion the grizzly bears were slow, dumb, and unaggressive. Finally, the abundance of bears at the dump, and their replacement by others when "regulars" were killed, promoted public perception of an abundant and productive resource. Until the marking program, few Faro residents realized that the dump was probably attractive and known to bears from a large area. The circumstances around dumps such as that in Faro do not portray the reality of northern interior grizzly bears; females mature late and are relatively unproductive, and bear mortality from human sources must be carefully regulated (Pearson 1975).

It is our opinion that viewing bears at a dump, compared to observing them in a wilderness setting, creates a very different public perception of the bear - one that is much less likely to be suited to the conservation of the species.

CONCLUSIONS

It is obvious that a lack of community planning and the absence of appropriate mitigation measures have resulted in serious bear management problems in the mining town of Faro. Subsequent attempts to rectify the lack of an appropriate refuse management regime have, in most part, failed. In 1987, following meetings with the town, a gate was installed restricting public access to the dump to 2 weekday evenings until 2000 hours and 2 weekend days until 1800 hours. A sign warning Faro residents of the bear hazard at the dump was installed, but was stolen within 2 days. In the autumn, 13 grizzlies were seen at the dump, and 1 grizzly was in the school playground when it was occupied by children. Safety courses to school children and interested adults continue.

Although community and mine officials were receptive to new strategies for disposing of refuse, funding for the new facilities was a very low budget priority. The benefits did not appear to warrant the expenditures. Unfortunately, this same attitude was expressed by most park agencies until the eventual loss of life provided a catalyst for improvements in solid waste management (Herrero 1985).

The situation at Faro remains a constant struggle for a compromise to the refuse-bear management dilemma. The real key is to prevent the same situation from developing in new communities in the north. Measures are needed to compel the mining industry to eliminate bear access to human foods and garbage throughout the phases of exploration, mine development, and operation. This will require research and legislation. Community designs will be needed that include practical and affordable garbage handling systems. The development of handling legislation and standards similar to those that regulate other mine by-products will provide the catalyst for long overdue improvements in garbage management.

LITERATURE CITED

HERRERO, S. 1985. Bear attacks - their causes and avoidance. Winchester Press, Piscataway, NJ. 287 pp.

LINDSEY, D. G., and B. L. SMITH. 1985. Reducing potential problems associated with bears and humans in the vicinity of Faro, Yukon. Yukon Fish and Wildlife Br. Tech. Rep., Whitehorse. 47 pp.

MAKALE AND KYLLO PLANNING ASSOCIATES LTD. 1981. Town of Faro Official Community Plan. Vol. 1: The plan and policies. Edmonton. 25 pp.

ORITSLAND, N. A., F. R. ENGLEHARDT, F. A. JUCK, R. J. HURST, and P. D. WATTS. 1982. Effects of crude oil on polar bears. DIAND Publ. No. QS-8283-020-EE-A1. Northern Affairs Environmental Studies No. 24. Ottawa. 268 pp.

PEARSON, A. M. 1975. The northern interior grizzly bear *Ursus arctos*. Can. Wildl. Serv. Tech. Rep. Ser. No. 34. Environment Canada, Ottawa. 84 pp.

TAYLOR, J. S. 1984. Bear management plans in Canadian national parks: fifteen essential elements. M.S. Thesis. Univ. of Calgary, Alberta. 232 pp.

THOMPSON, BERWICK, PRATT AND PARTNERS LTD. 1967. Anvil...Townsite Location and Development Study. Vancouver. 48 pp.

_____. 1968. Anvil...Townsite Location and Development Study No. 2. Vancouver. 54 pp.

THE IMPORTANCE OF ADVANCE PLANNING TO MINIMIZE BEAR-PEOPLE CONFLICTS DURING LARGE SCALE INDUSTRIAL AND TRANSPORTATION DEVELOPMENTS IN THE NORTH

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Abstract: The necessity of advance planning to minimize bear-people conflicts associated with large-scale development projects in the North is reviewed. Government agencies in the United States and Canada, as a rule, are responsible for providing a general framework of guidelines to minimize carnivore-related problems and, on some projects, for the development of specific stipulations that must be adhered to in order for industry to obtain authorization to proceed. This general approach taken by the United States federal and Alaskan state governments differs from the approach of the Northwest Territories and Yukon Territory in Canada, where territorial government agencies, often in cooperation with industry, have developed plans to minimize bear-people conflicts. These can then be adapted by permit applicants. Industry responsibilities in this matter encompass such features as project and facility siting, project design, and construction scheduling and planning, all with the intent of minimizing bear-people conflicts. It may be required of a permit applicant to develop a specific plan to meet this objective.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Bears are inquisitive animals with a highly developed olfactory sense. They are able to exploit opportunistically a wide range of foods and habitats. These characteristics, in combination with their ability to learn rapidly, bring them into conflict with people involved in large-scale industrial and transportation developments in the North. Most often this occurs because of the problems associated with solid waste management, especially kitchen wastes. Bears may quickly adjust to these new sources of food, and can pose a threat to the safety of workers and cause significant property damage. Bears that frequent worksites can temporarily stop a construction project (Follmann et al. 1980). This paper is intended to emphasize that, with proper planning in the conceptual stages of an industrial development, it is possible to minimize bear-people conflicts and their negative consequences.

Experience obtained during construction of the 1,300-km long Trans-Alaska Pipeline System (TAPS), during the mid-1970's, demonstrated that the problems with carnivores can be quite significant (Milke 1977, Follmann et al. 1980). Problems were expected, but not of the extent and seriousness actually experienced. As a result, neither the builders of TAPS nor the resource agencies involved, represented by the Joint State/Federal Fish and Wildlife Advisory Team, were initially prepared to deal with the escalating carnivore-related problems. Thirty-eight black (*Ursus americanus*) and grizzly (*Ursus arctos*) bears were killed over a 9-year period beginning in 1971 (Follmann et al. 1980). Adequate advance planning probably would have significantly reduced the number of bears destroyed as well as the costs associated with work stoppages and property damage. The experience of TAPS and of other smaller-scale projects has shown both resource agencies and industry that bear and other carnivore-related problems should not be ignored in the planning phases of a project. During the past decade, most large development projects in the North have dealt with this necessity to at least some degree (Follmann et al. 1980, U.S. Dept. Inter. 1980, Hosking 1984).

This paper outlines the current responsibilities of the United States and Alaskan government permitting agencies and those of industry for problem bear management related to development. It also discusses the most common causes for bear problems and suggests methods to alleviate them. Finally, it reviews some differences which exist between the American and Canadian situations in the North regarding the minimization of bear-people conflicts in association with development. Neither the American nor Canadian approaches are arbitrary, but rather are based on existing government policies.

I wish to thank several people with whom I have discussed portions of this material, namely A. Ott and R. Shideler for their insight into the Alaska Department of Fish and Game (ADF&G) Habitat Division's role in the permitting and environmental review process, and in providing access to material which reflects ADF&G's stance on the U.S. Department of the Interior's (USDI) 1002 Report on the Arctic National Wildlife Refuge (U.S. Dept. Inter. 1986); H. Hosking and R. Smith for comments on the Terror Lake Hydroelectric Project; and P. Gray for comments on policies concerning industrial development in the Northwest Territories. I am also grateful to many industry and government co-workers during the planning, construction and operation phases of TAPS and during the planning phase of the proposed natural gas pipeline in Alaska with whom I have had numerous conversations over the past 15 years in regard to the problems of and approaches to dealing with animal-people conflicts. I also appreciate the review comments of R. Shideler, J. Hechtel, M. Bromley, and 2 anonymous reviewers on earlier drafts of this manuscript; A. Jones for typing the manuscript; and the support of the Institute of Arctic Biology in its development.

APPROACH

The following discussion reviews information on U.S. federal and Alaskan state government policies regarding carnivore problems related to industrial development. In addition, other reports and manuals were reviewed that were prepared by Canadian resource agencies or prepared for industry by consultants. This is not an exhaustive review of policies and plans used in the North, as some reports prepared for private industry are proprietary and therefore not accessible.

References are used where possible, but many of the incidents and conclusions related in the following sections result from experience gained while working on the TAPS project during the design, construction planning, and construction phases, and on the proposed natural gas pipeline in Alaska during the design and planning phases. These unreferenced incidents relate to either personal experience or are derived from discussions with others.

The North, as used in this paper, refers to Alaska and to the Yukon Territory and Northwest Territories of Canada, where large-scale construction projects often traverse remote areas containing wildlife populations with little previous exposure to people. Although the North offers unique environmental and construction challenges, the recommendations and conclusions herein have application at lower latitudes.

GOVERNMENT CONSIDERATIONS

In Alaska, federal and state government agencies provide a general framework or guidelines, or in some cases more specific stipulations, with which industry must comply to obtain a permit (U.S. Dept. Inter. 1980, Hosking 1984). The permit applicant, however, must develop actual plans and methodologies to address guidelines and stipulations.

On some projects, such as the natural gas pipeline proposed by Northwest Alaskan Pipeline Company, stipulations were included in the right-of-way grant (U.S. Dept. Inter. 1980) that necessitated the development of plans dealing with specific issues. These stipulations required industry to consolidate all plans and procedures to comply with many state, federal, and project regulations pertaining to a specific issue. For example, 25 reports were required by Stipulation 1.6.1 (U.S. Dept. Inter. 1980), including one which specifically considered carnivores, entitled "Recommended Carnivore Control Program for the Northwest Alaskan Pipeline Project Including a Review of Human-Carnivore Encounter Problems and Animal Deterrent Methodology" (Follmann et al. 1980). This report, by meeting the demands of Stipulation 1.6.1, satisfied the requirements of Stipulations 1.8 - Quality Assurance and Control; 1.10 - Surveillance and Maintenance; 1.11 - Health and Safety; 2.1 - Environmental Briefings; 2.2.4 - Sanitation and Waste Disposal; and 2.16 - Hunting, Fishing and Trapping, but only insofar as these stipulations pertained to potential carnivore problems. In addition, 4 Alaskan statutes and 1 federal regulation were addressed by the above report. These concerned the taking of Fur Animals (5 AAC 81.090), General Provisions (5 AAC 81.120), Feeding of Game (5 AAC 81.218), Taking Game in Defence of Life or Property (5 AAC 81.375), and Airborne Hunting (16 U.S.C. 742 j-1). Thus, 1 report addressed elements of 12 separate regulations pertaining to carnivores, and satisfied the requirements of both federal and state authorizing agencies.

The current Alaska state policy is to continue providing general environmental guidelines, and more specific stipulations where needed, to which the applicant must respond. This approach is well-illustrated by the ongoing review concerning proposed exploration of the Arctic National Wildlife Refuge (ANWR) in northeastern Alaska. The Alaska Department of Fish and Game (ADF&G) review of the ANWR 1002 report entitled "Arctic National Wildlife Refuge, Alaska Coastal Plain Resource Assessment" (U.S. Dept. Inter. 1986) noted deficiencies such as failure to mention waste incineration and bear-proof fencing (Collinsworth 1987). The intent of identifying these deficiencies was not to have the U.S. Department of the Interior develop specific plans to minimize bear problems, but to request that it require industry to develop such plans prior to the initiation of further exploration activities. In this way, ADF&G is attempting to have incorporated in the initial planning stage, before the proposed exploration program is authorized, specific procedures for minimizing bear-people conflicts.

In contrast to this approach taken in Alaska by state and federal agencies, Canadian resource agencies in the Northwest Territories and Yukon, often in cooperation with industry, have taken the initiative by developing specific guidelines for dealing with bear-related problems. Clarkson et al. (1986) reviewed the current approach to dealing with problem bears in the north of Canada, especially the efforts of the Northwest Territories in reducing bear-people conflicts. The most thorough publication is that produced in the Northwest Territories by Bromley (1985) entitled "Safety in Bear Country: A Reference Manual". This comprehensive manual provides specific reviews and recommendations on various aspects of human activities and development in bear habitat. Included are specifics on camp design and operation, bear detection systems, bear deterrent methods, the use of firearms, and general information on the biology and behaviour of bears and how to avoid conflicts with them. The manual is an excellent source of information to industry and other people who spend time in areas frequented by bears. A similar approach by the Yukon Wildlife Branch of the Department of Renewable Resources is a report entitled "A Field Guide to Yukon Bears for the Exploration and Placer Industries" (Hamilton and Smith 1981). The content of this report is similar to that of the publication produced by the Northwest Territories (Bromley 1985), reviewing bear biology and ecology, and providing recommendations on camps, waste disposal, and deterrents, as well as information relevant to recreational users.

Even though detailed plans have been developed by Canadian agencies for use by various groups, each industrial project may be required to assure agencies that bear-people conflicts will be minimized. This could entail attendance at an agency-coordinated training session or actual development of a site-specific operation plan. This latter could be developed by agency staff without cost to industry, unlike the approach in Alaska, where industry would be expected to develop the plan at no cost to the agency.

INDUSTRY CONSIDERATIONS

The key to minimizing potential bear problems during development projects is to establish a policy early in the planning phase to ensure that such problems will be avoided. Such a policy would address all aspects of a proposed project, including the siting and design of permanent and temporary facilities, construction planning and scheduling, employee education and conduct in relation to bears, and the development of specific plans to deal with animal-related problems that can occur in spite of the best planning efforts. A critical policy that must be applied during all phases of a project is prohibition of animal feeding.

Siting of Facilities

Siting criteria for both permanent and temporary facilities in the North are normally based on geotechnical considerations such as the absence of thaw unstable permafrost, topography that will minimize earthwork, the year-round availability of water for camps and, in the case of pipelines, optimization of pump and compressor station spacing to maintain relatively uniform pressure. Often, only the more highly visible biological considerations, such as fish spawning beds or nesting sites of an endangered species, receive special consideration during siting. In Alaska, siting of facilities has not been planned specifically to avoid critical bear habitat or areas of concentration. However, such planning can reduce problems with bears and should always be included in the decision-making process. For example, it would be appropriate to avoid salmon (*Oncorhynchus* spp.) streams to which bears are seasonally attracted, and significant berry-producing areas used by bears regularly in late summer. During construction of the TAPS Marine Terminal at Valdez, a "people-proof" fence was built across a traditionally used bear trail. This fence was regularly damaged by bears (Follmann et al. 1980), a problem that could have been avoided had use of the site by bears been better understood prior to installation of the fence. Although geotechnical considerations are critical for project integrity, biological considerations should go beyond simply determining the presence of endangered species or fish spawning beds, and include bears and other wildlife species. This is particularly important for the siting of temporary and permanent camps where regular human presence will increase the probability of conflicts with bears, and for the siting of disposal sites used to dump materials that might attract bears.

Design of Facilities

Considerations for designing facilities to reduce bear problems can include such features as the layout of camps, selection of waste incinerators and, when necessary, design of bear-proof fences. These features for the most part are ancillary to the design of a project, be it a pipeline, roadway, or industrial plant. However, they can determine the success of a program to minimize conflicts with bears.

If unafraid of humans, bears will be attracted to camps by the odours of cooking food and kitchen wastes. Fences have been shown to be effective in deterring black and grizzly bears in small, remote industrial camps (Follmann and Hechtel 1983) and can prevent the casual naive bear from entering a camp. Assuming prohibition of bear feeding is enforced, bears will not be rewarded and therefore should not associate a camp with food. Proper camp maintenance can also add greatly to the reduction of attractants.

An efficient incinerator can eliminate garbage that would attract bears. Incinerators should have an efficient combustion system for wastes that can have a high moisture content, and be of adequate size to cope with the waste generated by a camp. Some incinerators on the TAPS project were too small. This problem, in combination with inconsistent maintenance, often resulted in stockpiling of large quantities of waste and improperly-incinerated refuse. Because camps north of the Yukon River were not fenced, bears and other carnivores had easy access to stockpiled wastes (Follmann et al. 1980). In addition, when incinerators were not operating properly, accumulated garbage and poorly combusted debris from the incinerators were hauled to disposal sites, to which animals were than attracted (Milke 1977). Proper incineration will alleviate most problems.

Scheduling and Planning for Construction

Scheduling and planning during the construction phase of an industrial project can minimize bear-people conflicts. Scheduling of activities in relation to bear habitats and movements is often overlooked. Yet scheduling is regularly considered in relation to migration and spawning of fish, calving of ungulates, especially caribou (*Rangifer tarandus*), and nesting of raptors. If bears are known to concentrate within the geographical bounds of a project during a specific time of the year, construction activities can be scheduled to avoid conflicts. This is particularly feasible in the North, where black and grizzly bears are in dens from approximately October through March (Pearson 1975, Reynolds et al. 1976, Ballard et al. 1982, Schwartz et al. 1987). Some construction activities in permafrost areas, such as installation of thermal piles, are best conducted when the ground is frozen. Thus, scheduling winter construction to avoid conflicts with bears is often consistent with normal construction practices. Denning areas are critical to survival of bears in the North, and efforts should be made to determine whether traditional denning areas exist within the zone of influence of a project so that disturbances can be avoided.

Planning construction activities when bears are active, and people more likely to encounter them, is more difficult. Prohibition of animal feeding, and strict adherence to procedures and policies requiring proper food storage and waste disposal, are critical at such times. These policies are relatively easy to enforce in a fenced camp site but are more difficult to enforce at remote construction sites, particularly pipeline or roadway projects where camps are spaced over a long right-of-way and work sites are constantly moving (Follmann et al. 1980). Animal-proof fences are not feasible in these situations, and workers at these sites are more likely to feed animals. Once bears become accustomed to easily obtained foods, they will continue to approach these sites and follow as work progresses along a right-of-way. It traditionally has not been considered cost-effective to have one person at a worksite responsible for enforcement of such policies. Serious penalties, including removal from a project, should be considered for workers who ignore animal feeding prohibitions, although even the threat of dismissal is not always an effective deterrent (Milke 1977, Follmann et al. 1980). In general, enforcement of camp and worksite cleanliness, and proper incineration and burial of residues, will reduce bear-people conflicts.

An essential support activity for large construction projects and industrial sites, especially in remote areas, is the transport of materials to camps and worksites, often using public roadways. Truckers using the Dalton Highway (a public limited access roadway) north of the Yukon River to haul supplies to Prudhoe Bay were not restricted by TAPS regulations because the oil field was not part of the pipeline project. These truckers caused many problems by feeding bears and other carnivores (Milke 1977), even after the TAPS became operational (Follmann et al. 1980). Only the Alaskan statute prohibiting animal feeding could be invoked to prevent this activity. Substantial efforts of project personnel to minimize bear conflicts could be undermined by activities of non-project personnel, especially if resource agencies lack adequate staff to effectively patrol remote areas. Efforts should be made to address this problem on future projects.

CONCLUSIONS AND FUTURE PROSPECTS

To minimize bear-people conflicts on large construction projects, it is essential to consider facility siting, facility design, and construction planning and scheduling. To assure regulatory and other agencies that these criteria are being adequately considered, the permit applicant may need to show concrete efforts in this direction. This can range from an agreement to attend a workshop on avoiding bear problems, as is possible in the Northwest Territories, to development of a project-specific plan to minimize animal-related problems (Follmann et al. 1980, Herrero 1982). Required attendance at an environmental education course is now standard practice in northern Canada for all workers on large-scale industrial projects. As well, environmental protection plans are often available, and plans specific to bear protection may be required. In most cases the nature, size, and duration of the proposed project will determine the level of action required. Large-scale, long-term projects such as roadways, pipelines, and mining sites usually will require a project-specific plan to minimize bear problems. In Alaska, where neither federal nor state agencies have developed such planning procedures, it is the responsibility of the industry permittee to develop plans including environmental briefings. Such briefings occur in a classroom setting and inform field workers before they enter a camp or worksite about bears, their dangers, and the critical need to avoid feeding them. The Yukon Territory has developed a video on bears specifically for environmental briefings (Yukon Department of Renewable Resources, no date). These briefings are important, whether conducted by agency biologists or by industry. However, experience suggests that any policies and procedures established for a project must be backed by significant enforcement and disciplinary action.

It should be apparent to industry that special provisions to avoid bear problems can be expensive. These could include building high-security fences at camps in remote areas, and retaining staff whose sole function is to enforce company policies that will alleviate bear problems, and possibly to deal with problem bears that are inevitable on any large-scale project. The TAPS experience has shown that initial investment in a well-planned and effective program to avoid bear-people conflicts would have been cost-effective had such a program been implemented at inception of field activities. Instead, many problems ensued over a period of 2 - 3 years that required significant investment of time by contractor and agency personnel, and significant cost to the builders of the TAPS. However, that expenditure was small compared to losses from property damage and work stoppages caused by food-conditioned bears. Adequate planning is a cost-effective method of project management.

The TAPS project demonstrated to both resource agencies and industry the need to adequately plan for avoiding problems with bears, especially in remote northern areas. Indications over the past decade are that resource agencies will not tolerate the problems experienced during TAPS on future projects. Similarly, it appears that industry, in many cases, is prepared to take the steps necessary to minimize bear-people conflicts when their projects are authorized. Although the potential negative effects of bears and other carnivores on the construction phase of a large-scale project are known, the long-range effects of development on bear populations are not. Several studies (Harding and Nagy 1980, Schallenberger 1980, Manville 1983, Tietje and Ruff 1983, Horejsi 1986, Mattson et al. 1986, Archibald et al. 1987) have attempted to address this problem, but more research is needed, especially in the North. However, if adequate measures to minimize bear-people conflicts are implemented during the construction and operational phases of a project, the long-term effects on bear populations should be greatly diminished.

Canadian studies have been largely funded by industry in an atmosphere of cooperation that both industry and government realize is important to minimize bear-people conflicts. The U.S. experience is, to a certain extent, adversarial. Not only are the resource agencies reluctant to conduct their own studies, but they will sometimes require reimbursement when agency personnel are required to monitor construction projects or deal with problem animals. The net effect of programs is largely the same whoever pays for them, but a spirit of co-operation between industry and the monitoring agencies would seem to be the better approach. In Alaska, at least, large-scale projects of the same magnitude as TAPS are not planned in the immediate future despite the large natural gas reservoir at Prudhoe Bay. However, all indications are that industry is prepared and willing to take steps necessary to minimize bear-people conflicts if and when their projects are authorized. It is certain that government resource agencies are ready to ensure that the TAPS experience is not repeated.

LITERATURE CITED

ARCHIBALD, W. R., R. ELLIS, and A. H. HAMILTON. 1987. Responses of grizzly bears to logging truck traffic in the Kimsquit River Valley, British Columbia. Int. Conf. Bear Res. and Manage. 7:251-257.

BALLARD, W. B., S. D. MILLER, and T. H. SPRAKER. 1982. Home range, daily movements, and reproductive biology of brown bear in southcentral Alaska. Can. Field-Nat. 96:1-5.

BROMLEY, M. 1985. Safety in bear country: a reference manual. NWT Dept. of Renewable Resources, Yellowknife. 120 pp.

CLARKSON, P. L., P. A. GRAY, J. E. McCOMISKEY, L. R. QUAIFE, and J. G. WARD. 1986. Managing bear problems in northern development areas. Pages 47-54 *in* M. L. Lewis, ed. Northern hydrocarbon development environmental problem solving: Proceedings of the 8th Ann. Meeting of the Int. Soc. of Petroleum Industry Biologists, Banff, Alberta. Sept. 1985. 374 pp.

COLLINSWORTH, D. W. 1987. Arctic National Wildlife Refuge (ANWR) 1002 Report. Memorandum to R. L. Grogan from the Alaska Dept. of Fish and Game, 2 January. 4 pp + 6 enclosures.

FOLLMANN, E. H., R. A. DIETERICH, and J. L. HECHTEL. 1980. Recommended carnivore control program for the Northwest Alaskan Pipeline Project including a review of human-carnivore encounter problems and animal deterrent methodology. Final Report prepared for Northwest Alaskan Pipeline Company, Contract No. 478085-9-K071. 113 pp.

_____, and J. L. HECHTEL. 1983. Abstract. Bears and pipeline construction in the far north. Abstracts Sixth Int. Conf. Bear Res. and Manage.

HAMILTON, T., and B. SMITH. 1981. A field guide to Yukon bears for the exploration and placer industries. Yukon Wildlife Branch, Dept. of Renewable Resources, Whitehorse. 52 pp.

HARDING, L., and J. A. NAGY. 1980. Responses of grizzly bears to hydrocarbon exploration on Richards Island, Northwest Territories, Canada. Int. Conf. Bear Res. and Manage. 4:277-280.

HERRERO, S. 1982. Bears and the proposed Canadian Pacific Railway construction camps in Glacier National Park, British Columbia. Report to MacLaren Plansearch Corp., Vancouver, British Columbia. 49 pp.

HOREJSI, B. L. 1986. Abstract. Industrial and agricultural incursions into grizzly bear (*U. arctos*) habitat in Alberta, Canada. Abstracts Seventh Int. Conf. Bear Res. and Manage.

HOSKING, H. 1984. On-site monitoring of construction of Terror Lake Hydroelectric Project, Kodiak, Alaska. U.S. Fish and Wildl. Serv. Rep. FWS/R7HR. 48 pp.

MANVILLE, A. M. 1983. Human impact on the black bear in Michigan's Lower Peninsula. Int. Conf. Bear Res. and Manage. 5:20-33.

MATTSON, D. J., R. R. KNIGHT, and B. M. BLANCHARD. 1986. The effects of developments and primary roads on grizzly bear habitat use in Yellowstone National Park, Wyoming. Int. Conf. Bear Res. and Manage. 7:259-273.

MILKE, G. 1977. Animal feeding: problems and solutions. Joint State/Federal Fish and Wildlife Advisory Team, Special Report No. 14. Anchorage, Alaska. 11 pp.

PEARSON, A. M. 1975. The Northern Interior Grizzly Bear (*Ursus arctos L.*). Can. Wildl. Serv. Rep. Ser. No. 34. 86 pp.

REYNOLDS, H. V., J. A. CURATOLO, and R. QUIMBY. 1976. Denning ecology of grizzly bears in northeastern Alaska. Int. Conf. Bear Res. and Manage. 3:403-409.

SCHALLENBERGER, A. 1980. Review of oil and gas exploration impacts on grizzly bears. Int. Conf. Bear Res. and Manage. 4:271-276.

SCHWARTZ, C. C., S. D. MILLER, and A. W. FRANZMANN. 1987. Denning ecology of three black bear populations in Alaska. Int. Conf. Bear Res. and Manage. 7:281-291.

TIETJE, W. D., and R. L. RUFF. 1983. Responses of black bears to oil development in Alberta. Wild. Soc. Bull. 11:99-112.

U.S. DEPT. OF THE INTERIOR. 1980. Grant of right-of-way for the Alaska Natural Gas Transportation Systems, Alaska Segment. Serial No. F-24538. 10 pp + 4 exhibits.

_____. 1986. Arctic National Wildlife Refuge, Alaska, coastal plain resource assessment. Draft Section 1002 Report. 172 pp.

YUKON DEPARTMENT OF RENEWABLE RESOURCES. No date. Arctic Bears, NN. A video produced by ESSA Environmental and Social Systems Analysts Ltd.

BROWN BEAR-HUMAN CONFLICTS IN THE KODIAK ARCHIPELAGO, ALASKA

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Abstract: Circumstances of 88 incidents in which 93 brown bears (*Ursus arctos*) were killed in defence of life or property from 1974-1986 in the Kodiak Archipelago, Alaska, were examined. Sex, age, and reproductive status of mortalities were analyzed. The leading sources of mortality were conflicts with deer (*Odocoileus hemionus sitkensis*) hunters (51%) and conflicts with residents of remote villages (23%). Deer hunters were also the leading source (53%) of defense of life or property incidents. An increasing trend in defence of life or property mortality indicates interactions between humans and brown bears are becoming more frequent. More females than males were killed and maternal females were killed more often than single females. The present level of mortality is probably not detrimental, but continued loss of mature females whose home ranges intersect villages and popular hunting areas could depress bear numbers in localized areas. A growing resident human population, increasing activity by outdoor recreationists, and development of private lands are predicted to result in increased bear-human conflicts. An accelerated program to educate the public to avoid conflicts with bears is recommended.

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The Kodiak Archipelago in southwestern Alaska is renowned for supporting high brown bear densities (Troyer and Hensel 1964) and for producing trophy bears (Nesbitt and Wright 1981). The area has recently gained a reputation for high quality salmon (*Oncorhynchus* spp.) and steelhead trout (*Salmon gairdneri*) sport fishing, and for Sitka black-tailed deer hunting. An influx of outdoor recreationists travelling to Kodiak, along with increased pressure from a growing local populace, has resulted in a significant increase in human activity and a corresponding rise in bear-human conflicts. Immediate concerns are increasing conflicts with deer hunters and inhabitants of rural villages on Kodiak Island. Future development and occupation of private lands in coastal areas are expected to produce chronic bear problems. The agencies with primary responsibility for managing bear populations and habitat, the Alaska Department of Fish and Game (ADF&G) and U.S. Fish and Wildlife Service (FWS), are faced with the task of improving bear management and habitat protection while operating budgets are decreasing. This paper examines current and predicted bear-human conflicts in the Kodiak Archipelago and discusses strategies for minimizing those conflicts. We have focused on defence of life or property (DLP) mortality of brown bears as the most reliable indicator of trends in bear-human conflicts.

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BACKGROUND

Brown bears were considered undesirable competitors by ranchers and commercial salmon fishermen, and wanton killing of brown bears was common in the early 1900's. Hunters and conservationists became concerned about the welfare of the Kodiak brown bear in the 1930's, and their efforts resulted in the establishment of the 7,680 km^2 Kodiak National Wildlife Refuge in 1941. Conflicts with livestock on northeastern Kodiak Island resulted in a controversial brown bear control program conducted by the ADF&G from 1964-1968 (Rearden 1964, Eide 1965).

The Alaska Native Claims Settlement Act of 1971 and the Alaska National Interest Lands Conservation Act of 1980 resulted in the transfer of 1,250 km^2 of public land to Alaska natives. Additional land has been sold by state and local governments for homesteads and recreational cabins. Consequently about 25% of the land in the Kodiak Archipelago is now privately owned. Because most of this land is important bear habitat, there is potential for adverse impacts on brown bears. Other recent land developments with potentially adverse effects on brown bears include commercial timber harvest on Afognak Island and the Terror Lake hydroelectric project on northern Kodiak Island.

The most significant trend in the Kodiak Archipelago in the past decade was the rapid increase in human use. The population of 13,952 residents increased 43% from 1980 to 1986 and it is expected to exceed 21,000 people by the year 2000 (Kodiak Island Borough, unpubl. data). Recreational use by local residents and by off-island visitors is increasing by about 10% annually. Over 7,000 people visited the Kodiak National Wildlife Refuge in 1984 and that number is projected to more than double by 1995 (U.S. Fish and Wildl. Serv., unpubl. data).

Interest in brown bears is growing among both the hunting and non-consumptive recreationists. There is a high demand for hunting the Kodiak brown bear by both resident Alaskans and non-residents. Brown bear hunting in most areas is regulated by a system with assigned hunting areas and limited permits. Visits to remote brown bear habitat by photographers and tourists appear to be increasing steadily.

Conflicts between humans and brown bears occur regularly and in varied circumstances in the Kodiak Archipelago. Conflicts with wildlife, including bears, can legally be resolved by killing an offending animal under a regulation passed by the State of Alaska in 1960. The regulation provides for the "taking of game in defense of life or property" by individuals, and defines legitimate circumstances for DLP killings (Miller and Chihuly 1987). Hides and skulls must be salvaged and surrendered to ADF&G, with a written report detailing the circumstances of the killing.

STUDY AREA

The Kodiak Archipelago consists of 16 major islands located east of the Alaska Peninsula in the Gulf of Alaska (Figure 1). The 2 largest islands, Kodiak (9,300 km^2) and Afognak (1,800 km^2), compose 87% of the land area and support most human activities (Buck et al. 1975).

Rugged topography, unpredictable weather, and dense vegetation characterize the archipelago. Major physiographic features include rugged mountains, rolling hills, broad valleys, and an irregular coastline with prominent headlands, cliffs, and deep, narrow bays. Weather patterns are strongly influenced by the Japanese current, and fog, drizzle, and high winds occur frequently. Temperatures are mild and annual precipitation exceeds 180 cm. Remote areas are accessible only by floatplane or boat. This poor accessibility tends to concentrate human activities and settlements in small areas.

Vegetation is typified by a moderate to dense shrub cover interspersed with lush, herbaceous meadows. Willows (*Salix* spp.), the dominant shrub in wet lowland areas, give way to alder (*Alnus crispa*) on drier sites. Large bog and heath communities occur in southwestern Kodiak Island. Extensive Sitka spruce (*Picea sitchensis*) forest occurs on Afognak and northern Kodiak Islands. Five species of Pacific salmon are found in the archipelago, with pink salmon (*O. gorbuscha*) and sockeye salmon (*O. nerka*) the most abundant. Large mammals include Sitka black-tailed deer, Roosevelt elk (*Cervus elaphus roosevelti*), mountain goat (*Oreamnos americanus*), feral reindeer (*Rangifer tarandus*), and brown bear. The brown bear population is estimated to exceed 2,700 bears, with the highest densities occurring on Kodiak Island (Barnes, V.G., Jr., R. B. Smith, and L. G. Van Daele, unpubl. rep., Alas. Dept. Fish and Game and U.S. Fish and Wildl. Serv., 1988).

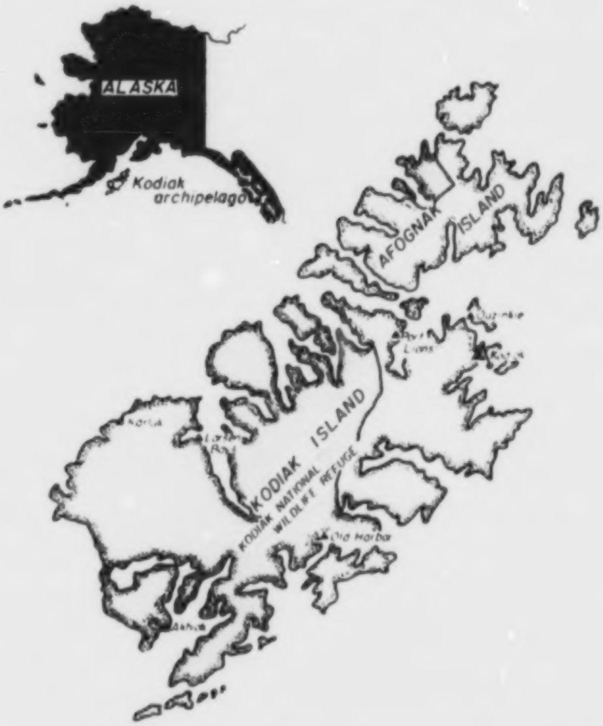

Figure 1. Kodiak Archipelago showing villages and the Kodiak National Wildlife Refuge (shaded) (1 cm = 11.5 km).

METHODS

We analyzed brown bear sealing records and written reports of people who killed brown bears in defence of life or property in the Kodiak Archipelago (Game Management Unit 8) from 1974-1986. This analysis was based on 88 separate incidents involving 93 individual bears. For DLP incidents in which hides and/or skulls were salvaged, standardized sealing forms in ADF&G files provided data on sex, cementum age, location of kill, and notes on circumstances of the kill. Anyone who kills a bear in defense of life or property is required to submit a written statement within 15 days detailing the incident. Statements examined ranged from 1 paragraph to several pages. Additional information was acquired from questionnaires filled out by individuals involved in DLP kills since 1985.

Over the past decade, ADF&G has given high priority to documenting DLP kills and enforcing the requirements for reporting and salvaging hides and skulls. Compliance with the reporting requirement is believed to be high in the Kodiak Archipelago relative to other areas of Alaska, but unreported kills are sometimes found. Where data were missing from a DLP statement, cross-referencing with sealing records usually filled the gaps. Occasional subjective judgements were required to interpret the reports, but we had personal knowledge of nearly all the incidents, having interviewed many of the individuals involved, and sealed the hides and skulls of bears killed.

We examined circumstances of the DLP incidents and assigned them to 1 of 8 categories. For analyzing seasonal occurrence and distribution of kills, the 8 categories were reduced to 3, including incidents involving hunters, bush and village residents, and other sources combined. We further examined the circumstances of 47 DLP kills of brown bears by deer hunters and classified them into incidents which occurred in the field and in camps. The sex and age composition of the kills and reproductive status of females killed were analyzed. Data from radio-collared bears, obtained in a study on the impacts of the Terror Lake hydroelectric project constructed on northern Kodiak Island from 1982-1985 (Smith and Van Daele 1988), provided additional insight into bear-human conflicts.

RESULTS

Hunters were most often involved in DLP incidents (61%) followed in order by residents of 5 remote villages, isolated bush residents, government fish and game managers, and commercial fishermen (Table 1). Deer hunters accounted for 87% of the bears killed by hunters.

Table 1. Sources of brown bear mortality in defence of life or property incidents, 1974-1986, Kodiak Archipelago, Alaska.

Source of incidents/ mortality	Incidents N	Incidents %	Bears killed N	Bears killed %
Deer hunters	47	53	47	51
Bear hunters	5	6	5	5
Elk hunters	2	2	2	2
Village residents	18	20	21	23
Bush residents	5	6	7	8
Government fish & game	4	5	4	4
Commercial fishermen	3	3	3	3
Other	4	5	4	4
Total	88	100	93	100

Table 2. Seasonal occurrence of defence of life or property brown bear mortality, 1974-1986, Kodiak Archipelago, Alaska.

	Source of mortality			Total mortalities	
Month	Hunter	Village/ bush resident	Other	N	%
January-May	4	1	1	6	6
June	0	2	3	5	5
July	0	1	2	3	3
August	3	2	3	8	9
September	3	3	0	6	6
October	27	13	1	41	44
November	15	4	1	20	22
December	2	2	0	4	4

Most DLP mortalities occurred in the fall with October (44%) and November (22%) accounting for the highest number of kills (Table 2). The highest seasonal incidence of bear kills occurred in October both for hunters (50%) and for village/bush residents (46%).

The DLP mortalities were distributed throughout the Kodiak Archipelago (Table 3). Northwestern Kodiak Island and the Afognak Island area sustained 60% of the kill by hunters. Northwestern and southeastern Kodiak Island, which include the villages of Port Lions and Old Harbor respectively, had the highest kill by village/bush residents.

Table 3. Spatial distribution of defence of life or property brown bear mortality, 1974-1986, Kodiak Archipelago, Alaska.

	Source of Bear Mortality							
Area	Hunter		Village/Bush Resident		Other		Total	
	N	%	N	%	N	%	N	%
Afognak and adjacent islands	16	(30)	1	(4)	2	(18)	19	(20)
NW Kodiak Island	16	(30)	10	(36)	2	(18)	28	(30)
NE Kodiak Island	8	(15)	1	(4)	0		9	(10)
SW Kodiak Island	11	(20)	6	(21)	4	(36)	21	(23)
SE Kodiak Island	3	(6)	10	(36)	3	(27)	16	(17)

Table 4. Circumstances of brown bear kills in defence of life or property by deer hunters, 1974-1986, Kodiak Archipelago, Alaska.

Circumstances of kills	Bear			Total	
	Male	Female	Unknown	N	%
In field					
Without meat	8	11	2	21	45
With meat	1	5	0	6	13
Camp Area	5	9	1	15	32
Unknown	1	3	1	5	11

For bear mortalities involving deer hunters, bears were more often killed while hunters were in the field than while they were at camp (Table 4). The presence of deer meat was a probable factor in 6 (22%) of 27 incidents in which hunters killed bears in the field. Establishing the precise circumstances of these kills was difficult because some statements were known or suspected to have been made misleading in order to avoid possible prosecution for an unjustified killing.

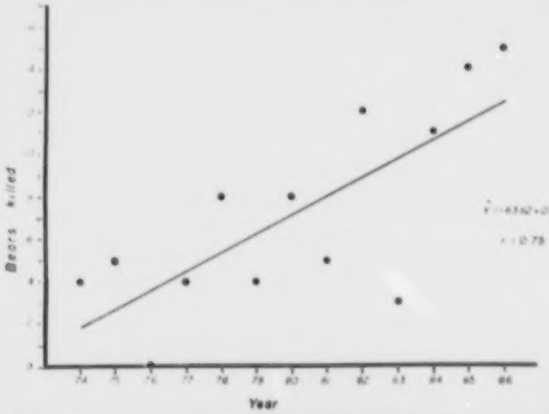

Figure 2. Defence of life or property mortality of brown bears in the Kodiak Archipelago, Alaska, 1974-1986.

An increasing rate of DLP kills of brown bears was evident since 1978 (Figure 2), with 60% of the mortality recorded in the past 5 years. Mean annual mortality for the periods 1974-1981 and 1982-1986 was 5.4 and 11.0 bears, respectively.

In the adult and subadult categories, females accounted for 43 (57%) of 76 DLP bears of known sex (Table 5). Adult females were killed more often (77%) than subadult females. Maternal females were killed more commonly than were single adult females. Among males, the number of adults and subadults killed was nearly equal.

Excluding dependent juveniles, the mean age of males killed was 7.3 years ($N=33$; range = 2.5 - 23.5 yrs) and the mean age of females killed was 11.6 years ($N=40$; range = 2.5 - 23.5 yrs). The mean age of all adult and subadult bears, including 2 of unknown sex, was 9.5 years ($N=75$; range = 2.5 - 23.5 yrs).

DISCUSSION

Conflicts with Hunters

The increasing incidence of bears killed in defence of life or property primarily reflects a large increase in deer hunting effort and harvest since the early 1970's. Brown bear and elk hunters were involved in only 8% of the DLP incidents (Table 1). Deer were introduced in 1924 and have recently reached a population high. Between 1972 and 1984 the estimated number of hunters increased from 590 to 3,950 and the estimated harvest increased from 690 to 8,900 deer (Alas. Dept. Fish and Game, Kodiak, Unpubl. data). Nearly 70% of the deer harvest occurs in October and November when bear foods such as salmon, berries, and herbaceous vegetation are waning. Because most of the deer harvest occurs in a narrow band of coastline along protected bays and freshwater lakes, a relatively concentrated food source is created each fall for bears. That bears are learning to associate deer hunting with easily available food is supported by the fact that 25 (53%) of 47 DLP kills by deer hunters occurred in the past 3 years (1984-1986), and 42 (78%) of 54 DLP kills by all hunters occurred in October and November.

Deer hunters killed bears while hunting and at hunting camps (Table 4). Most of the 27 bear kills which occurred while hunting were apparently chance

Table 5. Sex and age composition and reproductive status of brown bears killed in defense of life or property, 1974-1986, Kodiak Archipelago, Alaska.

Sex/Age[a]	Source of mortality: Hunters	Source of mortality: Village/ bush resident	Source of mortality: Other	Total	% of total with known sex
Male					
Adult	6	9	1	16	18.6
Subadult	11	3	3	17	19.8
Juvenile	0	1	0	1	1.2
Unknown	2	1	0	3	3.5
All males	19	14	4	37	43.0
Female					
Adult, single	9	1	1	11	12.8
Adult, maternal	12	4	3	19	22.1
Adult, unknown status	3	0	0	3	3.4
Subadult	5	3	2	10	11.6
Juvenile	0	4	0	4	4.7
Unknown age/ status	1	1	0	2	2.3
All females	30	13	6	49	57.0
Unknown Sex					
Subadult	1	1	0	2	
Unknown age	4	0	1	5	
All unknown sex	5	1	1	7	
TOTAL	54	28	11	93	

[a] Adult (≥5 yr); subadult (independent, ≥2 yrs and <5 yrs); juvenile (accompanied by female).

encounters, although bears may have been attracted to deer meat in 6 of 27 (22%) of the incidents. Attraction to deer meat was a factor in nearly all the camp incidents.

Bears were reported killed in a variety of circumstances, but competition for deer meat was a common theme. Even incidents which appeared to have been chance encounters may have been indirectly related to bears being attracted to areas with heavy deer harvest. Hunters increasingly report incidents in which bears suddenly appear at the scene of a deer kill intent on claiming it.

Brown bears are a legitimate concern to hunters in the Kodiak Archipelago, although the incidence of maulings is low. Seven people have been mauled since 1976, including 5 deer hunters, a bear hunter, and a sport fisherman (Alas. Dept. Fish and Game, Kodiak, unpubl. data). In 4 of 5 cases involving deer hunters, bears were attracted to deer meat. None of the 7 mauling victims received seriously debilitating injuries. Only 1 of the bears which mauled a deer hunter was killed.

Conflicts with Residents of Remote Villages

Chronic nuisance bear problems occur in the 5 remote villages on Kodiak Island. Although the annual reported DLP kill in villages averaged only 1.6 bears from 1974-1986, the actual kill was probably greater based on unverified reports from villagers and on the occasional finding of bears shot near villages (Alas. Dept. Fish and Game, Kodiak, unpubl. data).

The location of villages in high density brown bear habitat predisposes them to high levels of bear-human conflict. Two villages have salmon streams frequented by bears, and dense brush adjacent to the villages offers excellent cover. The major attractions for bears are the village landfill sites, most of which are located near roads within 1 km of the villages. Bears are also attracted to large quantities of fish and game which are usually stored near residences. Conflicts with bears at smokehouses and fish and game caches were noted in 6 of the 18 DLP incidents. Low availability of important natural food sources may result in more bear encounters near villages in some years. Smith and Van Daele (1988) attributed an unusually high incidence of bear-human conflicts at the village of Port Lions to a poor berry crop and failure of a local salmon run in 1985. Recent expansion of housing areas, construction of roads, airstrips, and small-scale hydroelectric facilities, and proliferating use of off-road vehicles have increased the likelihood of bear-human encounters near villages.

Conflicts with Other Human Activities

People living in or visiting remote areas in good brown bear habitat in the Kodiak Archipelago, whether engaged in work or recreation, encounter nuisance bear problems in circumstances similar to those previously described for village residents. Improper storage of food, garbage, or fish and game was frequently the cause of DLP incidents involving these people. Garbage dumps at seasonally operated fish canneries have been a frequent source of nuisance bear problems. Occasional confrontations with bears are routine for people living permanently at isolated sites. Seasonal residents, mainly commercial fishermen, inevitably have conflicts with bears attracted to waste fish and marine mammals killed incidentally to fishing operations.

Recent sales and leasing of government and private lands have resulted in an increase in the numbers of recreational cabins and residences in remote areas with high bear density. The lands chosen for development are characteristically near streams and protected coastal areas, which also are favoured by brown bears. Conflicts between bears and this new user group are predicted. Most permanently occupied residences have a history of nuisance bear problems whether or not incidents appear in the file of DLP reports. We suspect that bush residents, including seasonal residents, often do not report bears killed in defense of life or property.

Fish and game management personnel, who work close to areas where bears are concentrated, frequently experience problems with nuisance bears. A minimum of 12 salmon counting weirs are manned for 3-15-week periods each summer by 1-4-person crews on Kodiak and Afognak Islands. Mobile field crews monitor fishing and hunting activities and conduct research nearly year-long, with peak activity from April through November. Only 4 bears were killed by fish and game workers from 1974-1986 (Table 1), a remarkable record considering the high frequency of bear encounters they experienced.

Conflicts between brown bears and resource development activities have been relatively minor to date. Large-scale logging, which began on Afognak Island in 1975, has resulted in few nuisance bear problems. Since 1960, 3 bears are known to have been killed by forestry workers. Only 1 DLP bear kill was associated with the Terror Lake hydroelectric project on northern Kodiak Island, although in 1983 over 400 workers occupied the project site, where bear density was estimated at more than 1 bear/4 km^2 (Smith and Van Daele 1988). Use of an oil-fired incinerator, prohibition of firearms, presentation of frequent bear safety lectures to workers, and the presence of a government environmental monitor on the project contributed to the low incidence of serious conflicts with bears.

Conflicts between brown bears and sport fishermen are increasing. Sport fishermen were involved in only 1 of 88 DLP incidents from 1974-1986, but several bears were found shot near popular streams during that period. Numerous reports of conflicts between sport fishermen and bears have been received, along with occasional unverified reports of sport fishermen shooting bears. Commercial guiding of sport fishermen is rapidly increasing in the Kodiak Archipelago, threatening to concentrate large numbers of people in areas of high bear density.

Other "non-consumptive" recreationists, including photographers, campers, and hikers, are also susceptible to conflicts with brown bears. Photographers can be particularly intrusive. Incidents of photographers baiting bears and approaching bears at dangerously close range have been reported. One DLP kill by a photography guide occurred from 1974-1986.

Impacts of Kills on the Brown Bear Population

Presently the DLP kill in the Kodiak Archipelago is a relatively small mortality factor. From 1974 to 1986 the annual reported DLP kill averaged only 7.2 bears (range = 3 - 15) (Figure 2). The annual sport harvest averaged 147 bears during the same period (Alas. Dept. Fish and Game, unpubl. data). However, because DLP kills most often occur near villages or near popular deer hunting areas used heavily each year, the population could be reduced in localized areas. Mature females were particularly susceptible to DLP mortality from 1974-1986 (Table 5). Given that females have small home ranges (Smith and Van Daele 1988), we envision a situation where most adult females with home ranges intersecting a village or popular deer hunting area would eventually be killed. A high rate of unreported kills could further exacerbate this situation.

The loss of maternal females in DLP incidents impacts the population by direct mortality and by orphaning of cubs. Five cubs were killed and 35 cubs were orphaned in the 19 DLP incidents involving maternal females. Although cubs as young as 7 months may be self-sufficient (Johnson and LeRoux 1973), it is suspected that few cubs orphaned at less than 2 years old survive.

Loss of adult males and subadult bears to DLP mortality is undesirable, but probably has low potential for seriously impacting the bear population. Subadult bears, particulary males, are prone to conflicts because of their sometimes bold behaviour, which people often interpret as aggressive. Miller and Chihuly (1987) suggested that subadult males may be less sedentary than subadult females and therefore more likely to come into conflict with humans.

Strategies for Managing Brown Bear Conflicts

A combination of preventative and corrective measures is used to help resolve bear-human conflicts in the Kodiak Archipelago. Education programs, permit systems regulating commercial activities, and inter-agency consultations on proposed land developments are aimed at preventing nuisance bear problems.

Response to Problems • Complaints of nuisance bear problems are most often not given on-site attention by wildlife managers because of inadequate manpower and funding. Where a conflict appears to have long-term adverse implications or is an immediate threat to public safety, an on-site investigation may be made and advice offered on preventing further conflicts. A state law which makes it illegal to store food or garbage in a manner that attracts bears provides managers some leverage in getting people to clean up potential attractants.

Communication with Villagers • An adversarial relationship between some villagers and government agencies charged with protecting brown bears has hampered progress in solving nuisance bear problems in villages. Government agencies are often criticized for a "do nothing" approach because they will neither translocate nor kill nuisance bears. Villagers are becoming more aware that improvements in garbage disposal and food storage practices can reduce conflicts with bears, and village governments are expected to assign a higher priority to these problems in the near future. Replacing village landfills with oil-fired incinerators probably is the best alternative for reducing nuisance bear problems, but implementing the method may be difficult because of high cost.

A vigorous program of information and education in the villages is needed. The staff of the Kodiak National Wildlife Refuge recently began a program in the village schools to explain wildlife and land management activities, and plans to incorporate a segment on brown bear life history and bear-human conflicts in the near future. Occasional visits to villages to investigate nuisance bear problems and to conduct public meetings on wildlife issues have been too irregular to be effective.

A program was begun in 1983 to involve village public safety officers in a liaison role in nuisance bear situations. Communications between managers and villagers have improved with the assistance of the officers, but frequent turnover and inadequate training of new officers have been problems.

Bear Population Management • Maintaining the bear population below its carrying capacity with liberal hunting has long been the management policy in extreme northeastern Kodiak Island, where approximately 90% of the human population occupies less than 10% of the land. Although the bear population has increased there since the end of the intensive program of killing bears on cattle ranches in the 1960's, the bears are still sparse compared to other areas of the Kodiak Archipelago which are subject to much more conservative hunting regulations. Consequently, relatively few bear-human conflicts occur in this area despite high levels of human activity.

Land-Use Regulations • Regulation of land-use in the Kodiak Wildlife Refuge, although broadly addressing protection of habitat for all wildlife, specifically identifies prevention of brown bear-human conflicts as a major objective. Since 1983, special use permit systems regulating sport fishing guides, hunting outfitters, and recreational guides have been implemented on the refuge. The permit systems were initiated in response to a rapid development of commercial operations catering to hunters, sport fishermen, and other recreationists. The expansion of those commercial operations, if allowed to continue unchecked, was recognized as having high potential for increasing bear-human conflicts. A ceiling of 24 permits for sport fishing guides and 18 permits for transporter/outfitter operations was established. Additional time/area zoning restrictions were also imposed, along with limitations on party sizes. The intent of the special use permit system is to prevent displacement of bears from important feeding sites, reduce the risks of bears becoming conditioned to specific camp sites, and to provide high quality recreational opportunities (U.S. Fish and Wildl. Serv. 1987).

Regulation of non-guided recreational use of Kodiak National Wildlife Refuge is less stringent than that of commercial uses. General limitations on all refuge users, which are considered important to minimizing bear-human conflicts, include prohibiting use of off-road vehicles, jet-powered boats, and helicopter and wheel-plane landings.

Public Education • A variety of educational efforts, with a common theme of increasing public awareness of ways to avoid conflicts with brown bears have been implemented through cooperative efforts of ADF&G and FWS. Emphasis is on reducing attractions to bears, avoiding areas of high seasonal bear density, dealing with actual confrontations, and on realistically portraying the danger posed to humans. Efforts are directed at the general public, villagers, and bush residents. A brochure entitled "The Bears and You", which provides basic information on bear life history and avoidance, is distributed statewide at visitor centres and natural resource agency offices. Another brochure specific to Kodiak brown bears is distributed locally. Slide-talks and lectures to various local groups and interviews with local news media are presented frequently. The Kodiak National Wildlife Refuge visitor centre provides interpretive programs on a year-round basis with special emphasis on brown bears. The visitor centre draws a large segment of tourists as well as local residents, including school classes.

Educating hunters about avoiding conflicts with bears is particularly challenging. Hunters are armed and aware that a bear may be encountered. Many hunters believe that bears are particularly dangerous, a notion that has been reinforced by recent media attention focused on incidents in which deer hunters were mauled by brown bears in the Kodiak Archipelago. Deer and elk hunters are targeted in a brochure which provides information on how to hunt, camp, and care for game while avoiding bear conflicts in the Kodiak Archipelago. The real danger posed by brown bears is not downplayed in the brochure.

Hunters who visit the ADF&G office in Kodiak are routinely handed a copy of the brochure on avoiding bears and given a brief verbal warning to heed its contents. The brochures are also distributed locally at businesses and government offices frequented by hunters. Local and national news media, attracted by the sensationalistic nature of the problem, have nevertheless been cooperative in communicating essential points on avoiding bears to hunters. Frequent communication through all media of information on bear safety is considered important because Alaska has a transient population, which includes a large contingent of military personnel and many first-time hunters. Comments from hunters indicate that the information program has made progress and suggests that a further expansion of educational efforts is warranted.

Review of Land Developments • Major developments and resource extraction activities on public lands are subject to governmental interagency review for potential environmental impacts. The process provides an opportunity to direct developments away from sites with high potential for bear-human conflicts. Developments on private lands are subject to few restrictions and little opportunity is afforded wildlife managers to influence developments with potential for bear-human conflicts. An informal advisory program for informing the public and other agencies about living and working safely in brown bear habitat is conducted cooperatively by the ADF&G, the FWS, and the Alaska Department of Public Safety.

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

The issue of bear-human conflicts in the Kodiak Archipelago will increasingly challenge wildlife managers. Continued growth in the resident human population and increased exploitation of recreational opportunities in brown bear habitat will continue into the foreseeable future. We interpret increasing kills of brown bears in defence of life or property as an indication of a much higher level of bear-human interactions throughout the area, one that could have important long-term implica-tions. Available information indicates that the brown bear population of the Kodiak Archipelago is stable and has not been seriously affected by human activities. Nevertheless, we are concerned whether present management practices are adequate to maintain the current status.

Growing demands on the resources of the Kodiak area will require a greater commitment by state and federal agencies toward resolving bear-human conflicts. The need to upgrade current educational, advisory, and enforcement programs is clear. Specific tasks we have identified include improving the quality and distribution of educational pamphlets, increasing efforts to educate hunters on bear safety, preparing slide and/or video programs specific to Kodiak situations, improving information programs for village schools, and increasing efforts to solve nuisance bear problems in villages. The latter effort should improve the reporting rate of DLP kills in villages by improving the level of cooperation. Accomplishing these tasks would be a long-term contribution to the brown bear management program.

Available enforcement resources should be redirected to focus on critical areas and time periods when bear-human problems are most prevalent. In 1985, state and federal law enforcement officers began an annual patrol with the Kodiak National Wildlife Refuge marine vessel to monitor hunting activity and trouble-shoot nuisance bear problems in October and November. We believe that in-the-field contacts with hunters are important in preventing conflicts with bears and we recommend increased efforts in that regard.

Another priority is to improve compliance with DLP regulation. The law is necessary for the safety of people in bear habitats, but it can be misused for the unwarranted killing of bears. There is need for more prompt and aggressive investigation of DLP killings to differentiate between legitimate killings and killings for convenience. More strict enforcement of the DLP regulations carries the risk of a decreased reporting rate, however.

A continued increase in DLP brown bear kills may necessitate innovative measures to reduce and compensate for losses. On the Kodiak National Wildlife Refuge this might entail quotas on numbers of both commercial and non-commercial users of specific areas with high bear densities. Reducing the number of bear harvest permits in localized areas with high DLP kill will be considered. Modification of deer hunting regulations may be required to minimize conflicts between bears and hunters.

LITERATURE CITED

BUCK, E. H., W. J. WILSON, L. S. LACE, C. LIBURD, and H. W. SEARBY. 1975. Kadyak, a background for living. Arctic Environmental Inf. and Data Center Publ. B-75. Univ. Alas., Anchorage. 326 pp.

EIDE, S. 1965. The nature of brown bear predation on cattle, Kodiak Island, Alaska. Proc. Conf. West. Assoc. of State Game and Fish Commissioners. 45:113-118.

JOHNSON, L. J., and P. LEROUX. 1973. Age of self-sufficiency in brown/grizzly bear in Alaska. J. Wildl. Manage. 37:122-123.

MILLER, S. D., and M. A. CHIHULY. 1987. Characteristics of non-sport brown-grizzly bear deaths in Alaska. Int. Conf. Bear Res. and Manage. 7:51-58.

NESBITT, W. H., and P. L. WRIGHT. 1981. Records of North American big game. The Boone and Crockett Club, Alexandria, Va. 409 pp.

REARDEN, J. 1964. The Kodiak bear war. Outdoor Life 134 (2):17-19, 70-76.

SMITH, R. B., and L. J. VAN DAELE. 1988. Terror Lake hydroelectric project, Kodiak Island, Alaska - Final report on brown bear studies (1982-1986). Alas. Dept. Fish and Game, Kodiak. 182 pp.

TROYER, W. A., and R. J. HENSEL. 1964. Structure and distribution of a Kodiak bear population. J. Wildl. Manage. 28:769-772.

U.S. FISH AND WILDLIFE SERVICE. 1987. Kodiak National Wildlife Refuge, comprehensive conservation plan, wilderness review and environmental impact statement. U.S. Dept. Inter., Fish and Wildl. Serv., final internal review. 775 pp.

BEAR-PEOPLE CONFLICT MANAGEMENT IN DENALI NATIONAL PARK, ALASKA

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Abstract: Bear-people conflicts in Denali National Park increased dramatically during the 1970's as visitation to the park rose 7-fold. Incidents of property damage, bears obtaining human foods, charges, and injuries increased from less than 1/year prior to 1972 to a high of 37 in 1982. In 1982 a comprehensive effort was begun to reduce incidents. The bear-people conflict management plan was substantially revised. Two seasonal wildlife technicians were added to the park staff to work exclusively on the problem. Portable bear-resistant food containers were distributed to backpackers. Aversive conditioning was used on bears that had obtained food from back-country camps. As a result of this emphasis on preventative actions, since 1982 no management relocations or killing of bears have been necessary. Incidents have decreased by 81% parkwide, 60% in developed areas and 92% in the back-country. The number of incidents involving property damage decreased 88%. Monetary losses from damages declined 93%. Incidents of bears obtaining human food or garbage have decreased 95%.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Rapidly increasing visitation in national parks in the 1970's was accompanied by increases in bear-people conflicts (Martinka 1982). Visitation to Denali National Park doubled in 1972 when a paved state highway reached the park. Incidents of property damage, charges, injuries, and bears obtaining human foods increased from less than 1 per year prior to 1972 to 36 by 1982. This paper describes the management actions taken to reduce the incidents and the results of those actions.

We thank Al Lovaas for obtaining funding to start this program and for his continuing encouragement, and Doug Waring and Brad Shults for field assistance.

BACKGROUND

Denali National Park and Preserve consists of about 24,000 km^2 in south-central Alaska. Elevations range from 122 - 6,194 m, culminating in North America's highest peak, Mount McKinley. The lower areas consist of taiga dominated by black spruce (*Picea mariana*), white spruce (*P. glauca*), paper birch (*Betula papyrifera*), and quaking aspen (*Populus tremuloides*), with numerous lakes, streams and bogs. The foothills of the Alaska Range are chiefly covered by shrub communities of willow (*Salix* spp.) and dwarf birch (*B. glandulosa* and *B. nana*), with moist areas of cottongrass (*Eriophorum* spp.). Tundra plants such as mountain avens (*Dryas* spp.) and sedges (*Carex* spp.) are found on the mountain slopes to about 1,500 m, above which rock and glaciers predominate.

Grizzly (*Ursus arctos*) and black bears (*U. americanus*) inhabit the park. Grizzlies are most abundant in the foothills and mountains, while black bears rarely leave the forested lower terrain.

Most visitor use of Denali occurs along the 154 km gravel road that traverses the foothills and lower slopes of the north side of the Alaska Range. Transportation is primarily by shuttle and tour buses (Singer and Beattie 1986). At the east end of the road there are hotels and other services both in and out of the park. At the west end of the road there are a few lodges and a mining district. Seven campgrounds are located along the road.

Easy accessibility and open country make hiking into the back-country popular. There are no designated trails or campsites and use is dispersed throughout the open terrain. Hikers follow the broad, glacial river valleys or tundra ridges and slopes of the mountains. The area accessible from the road has the best grizzly bear habitat in the park. Dean (1987) estimated the minimum grizzly bear density for this area as 1 bear/44 km^2.

THE PROBLEM

Prior to 1972, bear-people conflicts in the park were not considered a serious management problem. Many years no incidents were recorded. From its establishment in 1917 (as Mount McKinley National Park) through 1971, only 4 injuries to people were reported. Ranger reports seldom mentioned problems. Adolph Murie studied wildlife in the park for many years between 1939 and 1970. Bear-people conflicts are rarely mentioned in his book on the park's grizzlies (Murie 1981).

In 1972 this situation changed with the opening of the state highway to the park. With the increase in recreational visits, bear-people conflicts increased (Table 1). By 1978 a bear incident reporting form was developed, rangers were equipped with immobilizing drugs, and a bear-human conflict management plan was prepared. In 1978, park staff reported 79 interactions.

Prior to 1982 a major management response to bear-people problems had been to remove the bears (Table 1). Open garbage dumps and poorly stored food attracted bears and led to most of the management relocations and removals prior to 1975. That year all dumps but 1 were closed. The 1 which stayed open was fenced, and in 1980 was replaced by a large holding tank from which garbage is trucked to a state landfill 100 km from the park.

Although bears were being denied garbage, problems continued to increase. Part of the problem was the sheer number of people in bear habitat. Unexpected encounters with bears resulted in defensive reactions by bears, such as charges. Bears were finding back-country campers' food caches, approaching campers who were cooking, or obtaining food from packs dropped by hikers during encounters (Table 2). Bears obtained poorly stored food or unprotected garbage on privately owned lands within or adjacent to the park, and then caused problems in the park. Some bears were killed by private landowners. Park regulations are not enforceable on private inholdings.

Efforts to educate campers about food storage and behaviour in bear country were made when people picked up their permits. As only 7% of back-country campers did not get a permit (Plager and Womble 1981), rangers were able to personally distributed written information and talk to most campers. Areas where conflicts had occurred were frequently closed to visitor use for weeks at a time. State regulations for food and garbage protection on private inholdings were not enforced until after a problem had occurred and a complaint had been lodged with state officials. Even then, the cause of the problems was rarely permanently corrected.

Despite dump closures, visitor education, area closures, and relocation or destruction of bears, overall problems did not decline. In 1982, the park began to evaluate its

Table 1. Annual visitation, injuries, incidents, and bear removals, Denali National Park, Alaska, 1917-1986.

Year	Visitors	Injuries	Incidents	Bears Removed[a]
1917-70	<40,000/yr	4	<1/yr	28
1971	45,000	0	0	2
1972	89,000	1	2	1
1973	137,000	3	4	1
1974	160,000	0	5	1
1975	161,000	1	10	1
1976	158,000	0	10	4
1977	170,000	1	21	2
1978	223,000	0	29	2
1979	287,000	0	28	4
1980	318,000	3	29	1
1981	262,000	0	25	1
1982	322,000	1	36	1
1983	346,000	0	31	0
1984	394,000	0	25	0
1985	436,000	2	21	0
1986	530,000	0	23	0
1987	575,000	2	7	0

[a] Management relocations or kills.

Table 2. Back-country camper-nights, injuries, and incidents, Denali National Park, Alaska, 1971-1987.

Year	Camper-Nights	Injuries	Incidents
1971	2200	0	0
1972	3500	1	0
1973	4000	2	0
1974	4000	0	3
1975	5800	1	2
1976	6800	0	2
1977	8300	0	10
1978	10000	0	23
1979	14100	0	19
1980	10400	2	25
1981	14200	0	21
1982	11700	1	26
1983	9400	0	22
1984	10400	0	12
1985	9700	0	14
1986	10300	0	14
1987	11800	2	3

actions and establish a comprehensive program of problem analysis, planning, and field management actions.

PROBLEM ANALYSIS

Denali's Resource Management Plan, a basic planning, programming and budgeting document, identified the need for conducting a problem analysis. The analysis used bear incident records collected by park staff (F. J. Singer, unpubl. rep., National Park Service, Anchorage, 1982). Key findings from this analysis were:

1. Problems in the front-country (the area within 0.5 km of roads or developments) seemed to have stabilized as sanitation management improved.
2. Problems in the back-country (the area more than 0.5 km from front-country) were increasing very rapidly, and the incident rate of 90 per 100,000 visitor-nights was extremely high compared to other parks with grizzlies. This situation was primarily due to inability of campers to secure their food, as 58% of cases were related to a food incentive at the campsite.

The number of bear incidents was significantly correlated to total visitation within back-country units. Interactions increased rapidly after a unit exceed 500 - 800 visits/year.

Recommendations were made for improving data collection, establishing clear decision guidelines for management action, setting research priorities, and testing the effectiveness of various management actions.

PLANNING

Concurrent with the problem analysis, planning was undertaken to revise the Bear-Human Conflict Management Action Plan. Findings from the problem analysis were then incorporated in this plan. Action plans are the operational parts of the Resource Management Plan. Planning was based on these policies:

1. The causes, not just symptoms, of problems must be treated. Total elimination of unnatural food rewards and management of human use must be the first priorities.
2. If these fail, aversive conditioning of bears will be tried before bears are removed or destroyed.
3. Attempts must be made to determine a bear's behaviour during an incident. Bears acting defensively or from natural curiosity while foraging will not be manipulated, unless conditioning to unnatural foods is likely to result.

The park's current plan contains a modification of the elements recommended by Taylor (1984) for bear management plans. The elements of our plan are objectives, organization structure, evaluation, monitoring, education, staff responsibilities, enforcement, regional management, budgeting, food and waste management, management actions in response to interactions, and research and training.

The plan also lists clear decision criteria to determine when action must be taken against a bear. These are used to determine the type of interaction that has occurred, the bear's behaviour, whether it is acceptable or not, and the appropriate response (Table 3).

A set of field guidelines further describes the specific management actions to be applied in a stepdown manner for 10 types of bear-human interactions that have often occurred in Denali. For example, if a bear is observed within ½ km of a developed area, extra warnings are made and patrols for sanitation problems are increased. If the bear starts to stay around facilities or people even though no food is obtained, a thorough review is first made of all reports to try to determine if the same bear is likely involved in each case. If so, the next step is to observe the bear's behaviour. We try to deter the bear from the area if it continues its pattern and appears likely to eventually become a conditioned bear. If that fails, and the bear becomes conditioned, the plan calls for radio-collaring the bear and trying aversive conditioning. Relocating the bear would be the next step, and finally if all else failed, destruction.

The plan has also assigned clear lines of responsibility; and annual evaluation, modification, budgeting and staffing are accomplished so the program receives consistent high priority.

The park's Wilderness Recreation Management Action Plan controls the extent and distribution of back-country visitor use. The park is divided into 44 units. Limited numbers of campers are allowed in each, with controls based on such factors as impact to vegetation, perceived crowding, disturbance to wildlife, and prevention of bear-human incidents. Only 2 - 8 people are permitted to camp in most units each night.

A study of the park's efforts to educate visitors in bear country was one element of our plan. Sundstrom (1984) found 74% of visitors knew the proper precautions for

Table 3. Criteria used in Denali National Park, Alaska to determine when a bear's behaviour in the presence of people requires management action towards the bear.

Behaviour Category	Human-Bear Interaction	Management Response
Foraging		
Curious	Bear shows inquisitiveness one time to identify a scent or object, then moves away.	None
Mistaken prey	Person acting like normal bear prey, or bear attacks in brush where it has been preying on moose calves, etc.	None
Defensive		
Dominance	Bear challenges intruder of its personal space by approaching, charging, or body language displays.	None
Surprise	Close, unexpected encounter; bear reacts, then leaves once person is no longer considered a threat.	None
Provoked	Person intentionally approaches close or harasses bear. Bear reacts, then leaves immediately.	None
Habituated		
Tolerant	Bears in areas also used by people; tolerates people nearby but ignores them and their facilities.	Monitor Deter
Conditioned	Repeat interest in people or their facilities; if allowed to continue, likely will result in obtaining unnatural food or will approach people or facilities.	Aversively condition Relocate Remove
Rewarded	Bear has obtained unnatural foods.	Aversively condition Relocate Remove
Aggressive		
Threat	Made repeated nondefensive charges or caused injury.	Destroy
Predation	Kills and consumes victim.	Destroy

avoiding conflicts with bears. The park's efforts significantly increased their knowledge; however, many visitors did not apply that knowledge. This indicated the park should make a major effort to convince visitors of the critical need to apply their knowledge. Park and concession employees had lower behaviour scores than visitors, pointing out the need for stronger attention to that group. As a result of this study, changes have been incorporated in the plan to increase the time spent with hikers explaining proper behaviour, and to increase training of employees. An experimental interactive computer system (Cuillard 1987) is being developed where hikers can place themselves in various simulated situations with bears, choose their behaviour and see the bears' reactions. If they choose wrong, they will see the consequences and be given the correct information.

Efforts to prevent problems on private lands within and adjacent to the park consist of monitoring garbage handling, offering assistance with designing appropriate bearproof facilities, and encouraging better state regulations and strong enforcement.

FIELD MANAGEMENT ACTIONS

Special Staff

In 1982 a biological technician was hired in the summer for bear-human conflict management. Since 1983 there have been 2 technicians. Their duties are to immediately respond to bear-human conflicts, investigate them, attempt to identify the bear involved, and take action according to the Bear-Human Conflict Management Action Plan. Because their time is dedicated solely to this work, they can stay with a situation continuously for days if needed. In the past when rangers had to deal with such problems they were often called away to perform other duties. The "bear techs" also patrol areas such as the park hotel, housing, campgrounds, and similar developed areas outside the park boundary for litter problems. They help train employees of the park and local businesses in safe practices in bear country. In the past we often could not investigate rumours of conflicts, but the bear techs now have the time to do this. This has resulted in greater knowledge of the actual number of problems and the details regarding them.

Bear-Resistant Food Containers

In 1982 we began a program aimed at reducing food-related problems with bears. Field tests were conducted to find a portable plastic food container for backpackers that would be resistant to bears. There are no trees for hanging food in much of the park, so hikers cached food on the ground where bears easily found it. Bears learned to seek out such food and to damage packs and tents while searching for food. Containers have been loaned to backpackers going into areas which have historically had the most problems. Containers have proven very effective in reducing problems and visitor acceptance of them has been very high (Dalle-Molle et al. 1986).

During 1982 through 1987, bears were reported present at sites a minimum of 106 times when containers were in use. Bears obtained food 20 times due to: 5 failures of early models of containers, 5 lids not latched completely by users, and 10 instances of food left outside the container, usually while people were cooking when a bear approached.

Deterring and Aversively Conditioning Bears

Park policy is to remove bears only as a last resort. Therefore, efforts are made to deter bears from sites before they obtain unnatural food, and to modify behaviour of bears conditioned to such food. We recognize that it is difficult to change the behaviour of a bear whose efforts have gained it a food reward in the past (McCullough 1982), but some success has been reported (Stenhouse and Cattet 1984; Derocher and Miller 1986).

Our plan calls for deterring bears from developed areas, before they become conditioned to unnatural foods, by making noise, firing cracker shells, or shooting them with soft plastic slugs fired from a 12 gauge shotgun. The slugs cause discomfort to the bear but bounce off. They have caused only minor localized tissue damage to the 2 bears we have examined.

When a bear is conditioned to unnatural food, we try to aversively condition it to avoid sites which it has associated with unnatural food rewards. As soon as a bear is reported to have obtained unnatural food, we go to the site. If there is a bear at or near the site, we observe its behaviour to see if it acts like a food-conditioned bear, that is, if it approaches the camp or people directly, is not deterred by noise-making and arm-waving, and fits the description of the bear involved in the incident. If it meets these criteria, we assume it is the bear that obtained food. We immobilize it by darting, and radio-collar it. If the incident happened at a developed site and the bear returns to the site or other similar sites, we shoot it with soft slugs. If the incident happened to back-country campers, we locate the bear about once a month throughout the summer and set up a tent simulating a backpacker's camp where the bear may notice it. If the bear approaches within 30 m of the camp, it is shot with a slug. We remain quiet inside the tent so the bear will hopefully associate the unpleasant experience with the camp rather than people, as bears have often raided camps at night or when hikers were away. We vary the model, colour and number of tents used. The behaviour of the bear is recorded from the time it notices the camp until it had moved 1 km away from the site.

Table 4. Aversive conditioning of bears in Denali National Park, Alaska 1984-1987.

Bear[a] No.	Sex	No. of tests	Reaction[b] DA	ID	A	No. times shot	Longest conditioned period[c]
1	F	17	2	7	8	4	3 years
2	F	5	3	0	2	2	1 year
3	F	10	1	3	6	2	1 year
4	F	3	1	0	2	1	3 years
5	M	3	2	0	1	2	3 days

[a] Bears 1-4 are grizzlies; 5 was a black bear; 3 had cubs with her during her last season of tests.

[b] Reaction to test. DA = Direct approach to test camp, essentially a straight line, no hesitation. ID = Indirect approach, circuitous, slow; A = Shows awareness of and avoids test camp.

[c] Longest time bear avoided test camps after aversive conditioning.

Five collared bears have been subjected to this form of aversive conditioning (Table 4). Three of these grizzlies and the black bear are known to have obtained food from back-country campers, acted unafraid of people making noise, and approached camps directly without hesitation. The history of bear number 4 is unknown. When we first encountered her, she behaved like food-conditioned bears in her direct approach, which was not deterred by yelling and waving, so we concluded she too had been getting campers' food. It is possible her behaviour was related to her extreme old age, and not conditioning to unnatural food. These radio-collared bears now act much more wary when near a camp than when the aversive conditioning first began. When they have made subsequent approaches, they have done so more indirectly and slowly than previously. Two have not approached our test camps in the past 3 consecutive seasons, and 2 have not approached the test camps in the past season.

After being shot at a lodge, bear 5 moved to a mining camp 1 km away and ate a large amount of meat left overnight in an open truck. It was killed by residents, ending our brief attempts at aversive conditioning.

In addition to the radio-collared bears, a black bear sow and 2-year-old cub broke into a developed site and got food. They kept returning over a 3-day period and were shot 5 and 4 times respectively, after which they ceased returning. A noncollared grizzly got food from construction workers and was scared off by a car horn and siren. A week later it was back at the site. During 2 days it was shot twice with slugs, and cracker rounds were also fired. It did not return until the following summer, when it was seen at this site once but did not cause problems. However, a bear fitting its description did approach vehicles and people on foot along a stretch of the road 5 km away.

DISCUSSION

Since the current efforts started, there have been decreases in every category we use to monitor the program's success (Table 5). In addition we have not had to relocate or kill any bears (Table 1). The decreases are likely even greater than shown, as incidents prior to 1983 were probably under-reported given the smaller staff available to track down reports. The decrease in problems occurred despite continually increasing visitation (Table 1) and the initiation in 1983 of several maintenance and construction projects that have put additional people in bear habitat. The decrease may in part be due to a 17% decline in back-country use since 1981, although the decrease in problems continued even in the years when use went back up (Table 2). The trend indicates continued success, although more remains to be done to further reduce problems.

Table 5. Number and percent decrease in bear-people conflicts in Denali National Park between 1982-1987.

	1982	1987	Percent Decrease
Parkwide incidents	36	7	81
Back-country incidents	26	2	92
Front-country incidents	10	4	60
Closure days	176	38	78
Property damage incidents	24	3	88
Property damage costs (U.S.$)	3030	220	93
Bears obtaining food/garbage	19	1	95

Although no bears obtained food from backpackers in 1987 for the first time in many years, additional containers are needed so that all backpackers can use them to prevent future food-conditioning of bears. Greater effort must be made to stress to users the importance of putting food in the containers and latching the lid correctly if they see a bear. Failure to do so has been a major cause of bears obtaining food. All injuries but 1 since 1980 have been due to surprise encounters or to photographers approaching too close to bears. Visitors must be better informed about the hazards of hiking in areas of restricted visibility, and education and enforcement of standards for photographers must increase. The value of deterrents and aversive conditioning, and their long-term implications to bear behaviour and habitat use, must be evaluated further. The role of habituation of Denali's bears to humans must be studied to determine if problems will occur with bears that are not conditioned to unnatural foods. New state regulations for proper food storage on private land, and stronger enforcement of existing garbage disposal regulations, are needed to prevent unnecessary killing of bears.

LITERATURE CITED

CUILLARD, J.D. 1987. Computers in the wilderness. Courier 32(2):15-16.

DALLE-MOLLE, J., M. A. COFFEY, and H. W. WERNER. 1986. Evaluation of bear-resistant food containers for backpackers. Pages 209-214 *in* R. C. Lucas, compiler. Proc. Natl. Wilderness Research Conf. Gen. Tech. Rep. INT-212, Intermountain Res. Station, Ogden, UT.

DEAN, F. C. 1987. Brown bear density in Denali National Park, Alaska and sighting efficiency adjustment. Int. Conf. Bear Res. and Manage. 7:37-43.

DEROCHER, A. E., and J. S. MILLER. 1986. Bear deterrent study (twelve gauge Ferret shell tests) Cape Churchill, Manitoba 1984. File Rep. No. 54. NWT Dept. of Renewable Resources, Yellowknife.

MARTINKA, C. J. 1982. Rationale and options for management in grizzly bear sanctuaries. Trans. North Am. Wildl. and Nat. Resour. Conf. 47:470-475.

McCULLOUGH, D. R. 1982. Behavior, bears, and humans. Wildl. Soc. Bull. 10:27-33.

MURIE, A. 1981. The grizzlies of Mount McKinley. Univ. Washington Press, Seattle. 251 pp.

PLAGER, A, and P. WOMBLE. 1981. Compliance with backcountry permits in Mount McKinley National Park. J. For. 78:155-156.

SINGER, F. J., and J. B. BEATTIE. 1986. The controlled traffic system and associated wildlife responses in Denali National Park. Arctic 39(3):195-203.

STENHOUSE, G., and M. CATTET. 1984. Bear detection and deterrent study Cape Churchill, Manitoba, 1983. File Report No. 44. NWT Dept. of Renewable Resources, Yellowknife.

SUNDSTROM, T. C. 1984. An analysis of Denali National Park and Preserve's management program to educate visitors regarding behavior while in bear country. M.S. Thesis, Univ. Wyoming, Laramie. 291 pp.

TAYLOR, J. S. 1984. Bear management plans in Canadian National Parks: fifteen essential elements. M.S. Thesis, Univ. Calgary, Calgary, Alberta. 347 pp.

MANAGEMENT OF BEACH CAMPING TO REDUCE HUMAN-BEAR CONFLICTS IN GLACIER BAY, ALASKA

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Abstract: Black bears (*Ursus americanus*) concentrated in large numbers on certain beaches in Glacier Bay National Park, Alaska. Soon after the bears emerged from their dens, they were attracted to beach meadows where they foraged on grasses and sedges. Comparing levels of seasonal visitor use with patterns of habitat use by bears made it possible to predict when and where human-bear conflicts might occur. To avoid such conflicts, beach meadows with a high density of foraging bears were closed to overnight camping. Black bear numbers in the beach meadow habitats were monitored prior to and during the closed periods. The restriction of human use in certain beach meadows during critical periods of May and June resulted in a reduction of bear incidents at those locations. The restrictions will help maintain a wild and natural black bear population.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Glacier Bay and surrounding lands were entirely covered by ice less than 200 years ago. Rapid glacial retreat has exposed a complex series of inlets and fjords surrounded by mountain ridges ranging from 500 to 1800 m in altitude. These steep-walled fjords are interspersed with gently sloping valleys formed by erosion and glacial outwash.

Pioneering plant communities proliferate in the upper reaches of the bay, while spruce forests have begun to dominate the shoreline of the lower bay. These spruce forests and adjacent beach meadows provide attractive habitat for black bears. The moderate maritime weather of southeastern Alaska ensures that these low-altitude habitats are free of snow by late spring.

The concentration of bears along narrow strips of beach vegetation each spring increases the likelihood of their encounters with humans. Efforts to reduce these encounters are confounded by increasing human visitation and the common use of beaches for camping in Glacier Bay. Wilderness camping has shown a continued upward trend since 1970, when only 85 of the 20,325 park visitors stayed at wilderness campsites. In 1986, total park visitation reached 146,967, with 1,164 campers spending an average of 4.78 nights at wilderness campsites. The remaining park visitors are on cruise ships or tour boats and never set foot on land.

This paper reviews the history of human-bear conflicts in Glacier Bay. It also describes seasonal patterns of visitor use and evaluates patterns of habitat use by bears on remote beaches. This information has been used by park managers to predict where conflicts might occur and to take measures to prevent such incidents.

HUMAN-BEAR INTERACTIONS

An increase in wilderness camping during the last decade has resulted in an increasing number of "bear incidents" (defined as property damage, consumption of unnatural food, or personal injury caused by black bears). Prior to 1978, bear incidents were infrequent and never exceeded 2 per year. Between 1978 and 1986, the popularity of sea kayaking resulted in a steadily increasing number of person-nights at wilderness locations, and a variable but increasing number of bear incidents (Table 1). Most of these bear incidents were caused by the storage of food contrary to park regulations or guidelines.

Black bears have been involved in only 2 documented attacks on humans in Glacier Bay. One attack resulted in only a minor injury to a sleeping camper, while the other resulted in a human fatality. The fatal attack

Table 1. Number of wilderness person-nights and black bear incidents, Glacier Bay, Alaska, 1976-1986.

Year	Wilderness person-nights	Bear incidents
1976	1927	0
1977	1927	0
1978	2739	4
1979	2770	3
1980	2224	4
1981	3428	3
1982	2628	10
1983	3159	2
1984	2628	19
1985	3750	3
1986	5564	9

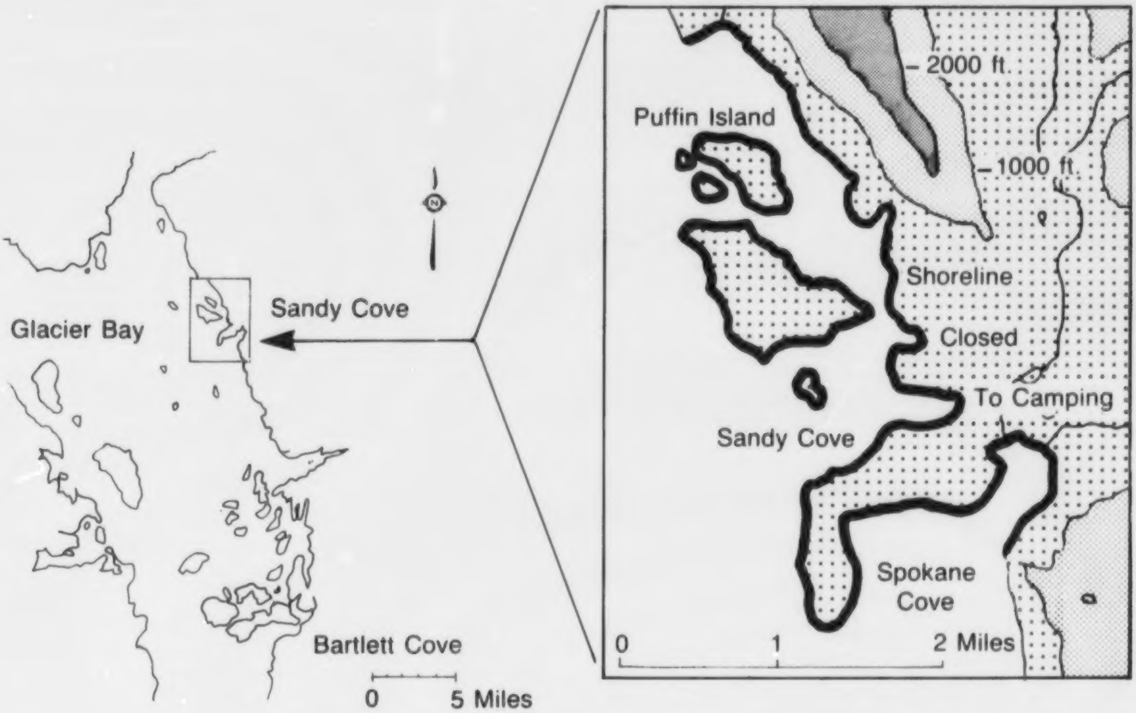

Figure 1. Sandy Cove Bear Management Area, Glacier Bay, Alaska.

occurred at Sandy Cove in 1980 and initiated the policy of closing bear foraging sites to overnight camping. These closures were intended to ensure the safety of campers and to help preserve a wild and natural bear population.

Although the number of human-bear conflicts is lower in Glacier Bay than in some other national parks, this reflects, in part, the low level of wilderness use by campers and hikers. Informed management decisions are required to prevent further conflicts as visitor use increases.

HABITAT USE BY BEARS

The use of shoreline habitats by black bears in Glacier Bay was evaluated based on sighting records collected during systematic surveys of Sandy Cove, Spokane Cove, and several outlying islands. This area was chosen because of the high concentrations of black bears reported by park rangers during routine patrols, and because of its past history of human-bear interactions. During May, June, and July of 1982 to 1984, weekly surveys were conducted from a small motorized skiff along a 22-km length of shoreline (Figure 1). Surveys were conducted between 1200 and 1800 hours and usually required about 3 hours to complete.

In 1985, a more extensive study was directed towards identification of individual bears and the assessment of their habitat. From April 25 to July 10, bears were observed and photographed from a raft anchored in the centre of Sandy Cove. Observations were conducted during 38 days and included the standard 3-hour skiff surveys beginning between 0600 and 1800 hours. The beach and adjacent forest were examined to locate bear trails and bedding areas. Food habits were determined from examination of scats and direct observations of feeding.

The surveys indicated that black bears first move to beach meadows in late April, soon after emerging from their winter dens. Sightings of bears were common throughout May and decreased abruptly by mid-June. Sightings of bears along the beach were rare throughout July.

On their first arrival in April, bears fed predominantly on beach rye grass (*Elymus arenarius*). By mid-May, sedges (*Carex* spp.) were the most common forage. These 2 vegetation types were the predominant component in 89% of the 357 scats examined during May and June. Other less commonly used shoreline vegetation included horsetails (*Equisetum* spp.) and cow parsnips (*Heracleum lanatum*). A few bears were also observed eating barnacles (*Balanus glandula*), scraping the shells off intertidal rocks with their claws and teeth. Lindzey and Meslow (1977) found that the availability of food and cover were the primary factors contributing to the high seasonal concentrations of bears at local areas.

The ripening of berry crops in late June coincided with the decline of bear sightings along most shorelines, with the exception of a few beach meadows which contained extensive strawberry (*Frageria chiloensis*) patches. The return of spawning chum salmon (*Onchorhynchus keta*) and pink salmon (*O. gorboscha*) in August resulted in a further reduction of bear activity along beaches.

Adult males or non-parturient females accounted for the majority of shoreline use in the Sandy Cove study area. During 1985, 19 individual bears were identified prior to the mid-summer moult, from sketches and photographs of distinct colour blazes or scars. All of these were judged to be more than 2 years old and none were observed with accompanying cubs. During the previous 3 years of early-summer surveys, sows with cubs were observed only twice. Small bears, judged to be less than 2 years old, were seen infrequently and generally along isolated stretches of beach where few other bears travelled.

These patterns of shoreline use were consistent with the reports of other more detailed studies. The high tides of spring helped to melt shoreline snow and promoted the early growth of vegetation. The grasses and sedges provide food and bedding for bears during spring and early summer (Newsom 1936). The importance of these food types and the shoreline habitat decreases as berries and salmon become available (Landers et al. 1979). Although it was not possible to determine the sex or exact age of bears in this study, adult males seemed to be the predominant users of the shoreline in Glacier Bay. Harvest statistics and hunter field observations indicate that male black bears were the most frequent users of beaches in Prince William Sound, Alaska, a coastal habitat similar to that of Glacier Bay (McIlroy 1972).

MANAGEMENT IMPLICATIONS

The challenge to park management is to provide protection of a natural bear population and to provide for visitor safety. The ease with which black bears become habituated to contact with humans and human foods complicates the human-bear management problem (McCullough 1982). The success of any human-bear management is dependent upon the removal of unnatural food sources. Most bears become "problem bears" as a result of improper food storage (Harms 1977).

Table 2. Comments concerning unusual bear behaviour while at campsites - Glacier Bay, Alaska, 1984.

Bear behaviour	Percent responses
Eating camper's food	13.3
Entered campsite	11.9
Bold behaviour	10.4
Went through gear	6.0
Approached campers	3.0
Damaged camper's gear	1.5
Other wildlife behaviour	53.9
Total	100.0

A 1984 sociological survey in Glacier Bay (Salvi and Johanson 1985) reported that 33.8% of wilderness campers saw black bears. Many of those campers reported unusual bear behaviour (Table 2).

The park improved dissemination of information and initiated requirements to reduce improper food storage practices in back-country areas. However, these practices are not totally effective. Successful management of human visitors and bears should include closures of important bear foraging sites during periods of intense use by bears. The closure of Sandy Cove to overnight camping was logistically feasible because nearby islands and beaches served as alternative campsites for kayakers. These closures contributed to a reduction of bear incidents.

Bear surveys in areas that historically have had a high number of human-bear incidents should be conducted each spring to identify potential trouble sites. On-site tracking and scat examination, along with examination of the quality and quantity of forage items, will improve predictions of patterns of use by black bears.

Glacier Bay National Park has adopted a strict interpretation of the National Park Service Management Policy:

> "....strive to maintain the natural abundance, behavior, diversity, and ecological integrity of native animals in natural portions of parks as part of the park ecosystem" (U.S. Dept. Inter. 1978)

Continued monitoring of the patterns of habitat use by bears will provide necessary objective data. Management action can then be taken to protect the bears' natural behaviour and diversity by recognizing that people cause most "bear problems".

LITERATURE CITED

HARMS, D. R. 1977. Black bear management in Yosemite National Park. Assoc. of State Game and Fish Comm. 57:159-181.

LANDERS, L. J., R. J. HAMILTON, A. S. JOHNSON, and R. L. MARCHINTON. 1979. Food and habitat of black bears in southeastern North Carolina. J. Wildl. Manage. 43(1):143-153.

LINDZEY, F. G., and E. C. MESLOW. 1977. Home range and habitat use by black bears in southwestern Washington. J. Wildl. Manage. 41(3):413-425.

McCULLOUGH, D. R. 1982. Behavior, bears, and humans. Wildl. Soc. Bull. 10:27-30

McILROY, C. W. 1972. Effects of hunting on black bears in Prince William Sound. J. Wildl. Manage. 36(3):828-837

NEWSOM, W. M. 1936. Mammals of Anticosti Island. J. Mamm. 18(4):435-442.

SALVI, W. C., and D. R. JOHANSON. 1985. Glacier Bay Backcountry User Study 1984. Statistical Abstract. U.S. Natl. Park Serv. report. 156 pp.

U.S. DEPARTMENT OF THE INTERIOR. 1978. Management Policies. Natl. Park Serv. 128 pp.

THE PROBLEM BEARS OF FINLAND

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Abstract: The minimum calculated population of brown bears (*Ursus arctos*) in Finland increased over the first few years (1979-1982) of the annual census, with an estimated maximum of 465 individuals. However, the population decreased during 1983-1986. Annual hunting mortality is too high for Finland's isolated bear population. The population is partly isolated by a series of fences along Finland's eastern border and by the sea to the south and west. However, some interaction with the bear population of Soviet Karelia does occur. English Ritchey tags were used to identify marked bears. Bears were tracked with the aid of dogs and traps. The period of inactivity of brown bears in Finland lasts approximately 7 months. The 5-month active period is divided into 6 special seasons. Economic losses first occur during the first meat-eating season in May-June, next occur during the biomass-eating season (agricultural crops) in August, and finally during the second meat-eating season in August-September. The Government of Finland compensates farmers for agricultural and livestock losses caused by bears. To minimize the economic loss caused by bears, and to encourage avoidance of humans, bears are hunted in northern and eastern Finland during 2 separate hunting seasons. Females with cubs and yearlings, bears guarding a kill, or wounded bears are dangerous. Attacks against people increased between 1976 and 1986. Since 1981, attacks have increased by 42%. At present, there is no literature available to Finnish people on how to handle bear problems or how to behave during human-bear encounters.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

The brown bear is presently found throughout Finland, and its tracks can be observed on roads near villages as well as on the shores of the country's 60,000 lakes. Between 60% and 80% of the bear population lives in eastern Finland, and moves every autumn to the border zone of Soviet Karelia, where winter dens are often located. Many of the same bears return to Finland during the active period. Occasionally, brown bears living in northern Finland move into Norway and Sweden (Nyholm 1986*a*). This paper is based on 30 years of work (1956-1986) with brown bears in Finland.

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MATERIALS AND METHODS

Brown bears have been hunted and tracked by dogs since 1952 in order to study their hunting behaviour, social interactions, and breeding behaviour. Since 1956, brown hears have been trapped (N=36) in steel traps (Nyholm 1986*b*). Initially, the traps were used to harvest bears; however, since 1979 the traps have been used for scientific purposes. Bears were tranquilized and marked in both ears with Ritchey plastic tags. Bears were trapped in the districts of North Karelia, Suomussalmi, and Kuusamo. Morphological measurements were collected and age was determined using premolars extracted from captured bears (Birger Jensen, pers. commun.). A claw was removed to allow biologists to identify individual bears by their tracks. Some adult males (N=9) and females (N=4) were moved 140 - 450 km to other districts to evaluate their homing ability, and to enhance the genetic stock of local, isolated populations in the Bothnian Gulf area and in the area where several fences occur on the border zones between Soviet Karelia and Finland.

Beginning in 1979, bears were tracked with dogs and their movements were mapped. This was done every other day, during different times of day, until the bear entered the den in the fall. Movements of individual bears were mapped in the districts of North Karelia, Kainuu, Kuusamo, Salla, and Sodankylä. If the track of an individual bear was lost, it was usually found again by driving the network of new roads made by the Forestry Branch of the Government of Finland. Occasionally, tracks of some bears were lost for 1 - 2 weeks during periods of bad weather. However, the bears was usually found in the spring near a fresh kill, or in the summer near crops, or in the autumn close to a carcass (Nyholm 1982).

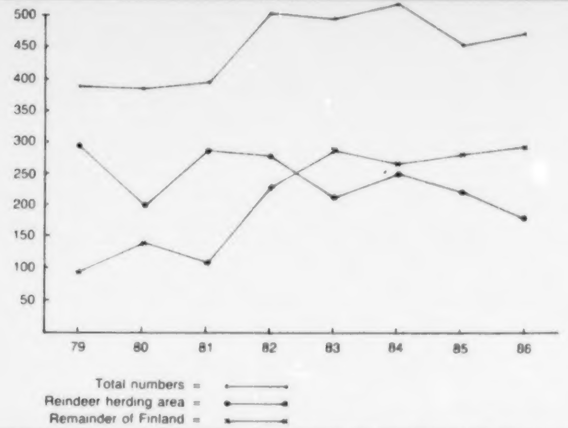


Figure 1. Observations of brown bears in Finland 1979-1986.

RESULTS AND DISCUSSION

Population Densities of Brown Bears

The minimum calculated population of brown bears has increased consistently since the 1930's and 1940's, and during the first 5 years of the annual census begun in 1979. The minimum estimated population was highest in 1982 with approximately 465 individuals; however, it decreased between 1983 and 1986 (Figure 1). The decline is probably due to heavy hunting pressure which resulted in the removal of an average of 65 bears annually between 1983 and 1986.

The estimated density of brown bears in 1985 was less than 2/1,000 km^2 in 13 Finnish districts, and 2.1 - 6.0/1,000 km^2 in the districts of Kymi and North Karelia in eastern Finland (Figure 2). Results from 1986 surveys indicate that density patterns are changing, with 2.1 - 4.0 bears/1,000 km^2 in Kainuu, Keski-Suomi, Pohjois-Karjala, and Kymi.

Annual Pattern of Human-Bear Conflicts

Field observations (N=382) indicate that the year of the brown bear in Finland can be divided into 2 periods: 7 months of inactivity and 5 months of activity. The active period consists of 6 special seasons of varying lengths based on food eaten. Bears in Finland have adapted to natural and unnatural foods available on a seasonal basis.

Brown bears are not usually noticed in an area until their prey is found in the spring and conflicts with people begin. Bears kill livestock during the first meat-eating season, which lasts for 30 - 37 days in May-June (Nyholm 1986*c*). Most attacks on livestock (80.1%) are by adult male bears. This is the first season during the active period when economic losses occur as a result of predation on moose, domestic reindeer, and livestock (Figure 3).

Human-bear conflicts next occur during the biomass-eating season in August when bears feed in oatfields. In addition to crop damage, several cutting-threshing machines have been damaged and oat posts pushed over and scattered by bears.

The third period of human-bear conflict occurs during the second meat-eating season, which lasts 1 - 1.5 months beginning in August. The bears prey upon moose, reindeer, other deer, and livestock. They also cause damage to orchards, beehives, and fur farms. The Government of Finland compensates for damage caused by bears to crops and livestock (Figure 4). For example, the average annual compensation rate was 445,224.24 Finnish Marks (about $103,340 CN) for bear-killed reindeer between 1978 and 1986. The Finnish Government will not compensate in cases where it can be proven that a bear attack was provoked by humans.

The open season for bear hunting in the Reindeer Herding Area is 1 May - 15 June and 1 September - 15 October; the open season is 1 September - 15 October in the North Karelia area. Brown bears are protected throughout the year in the rest of Finland (Figure 5). In addition, it is important to note that females with cubs are protected throughout Finland whether they are problem bears or not (Nyholm 1985).

Bear Attacks on People

The behaviour of brown bears in areas where they are completely protected is much different than in areas where bears are not protected. Protected bears more readily adapt to humans and show less fear of humans. Such bears are particularly dangerous in interactions with people. Any inappropriate behaviour on the part of the person may cause the bear to attack (Nyholm 1983*a*, *b*). This is particularly true during the bear's mating season.

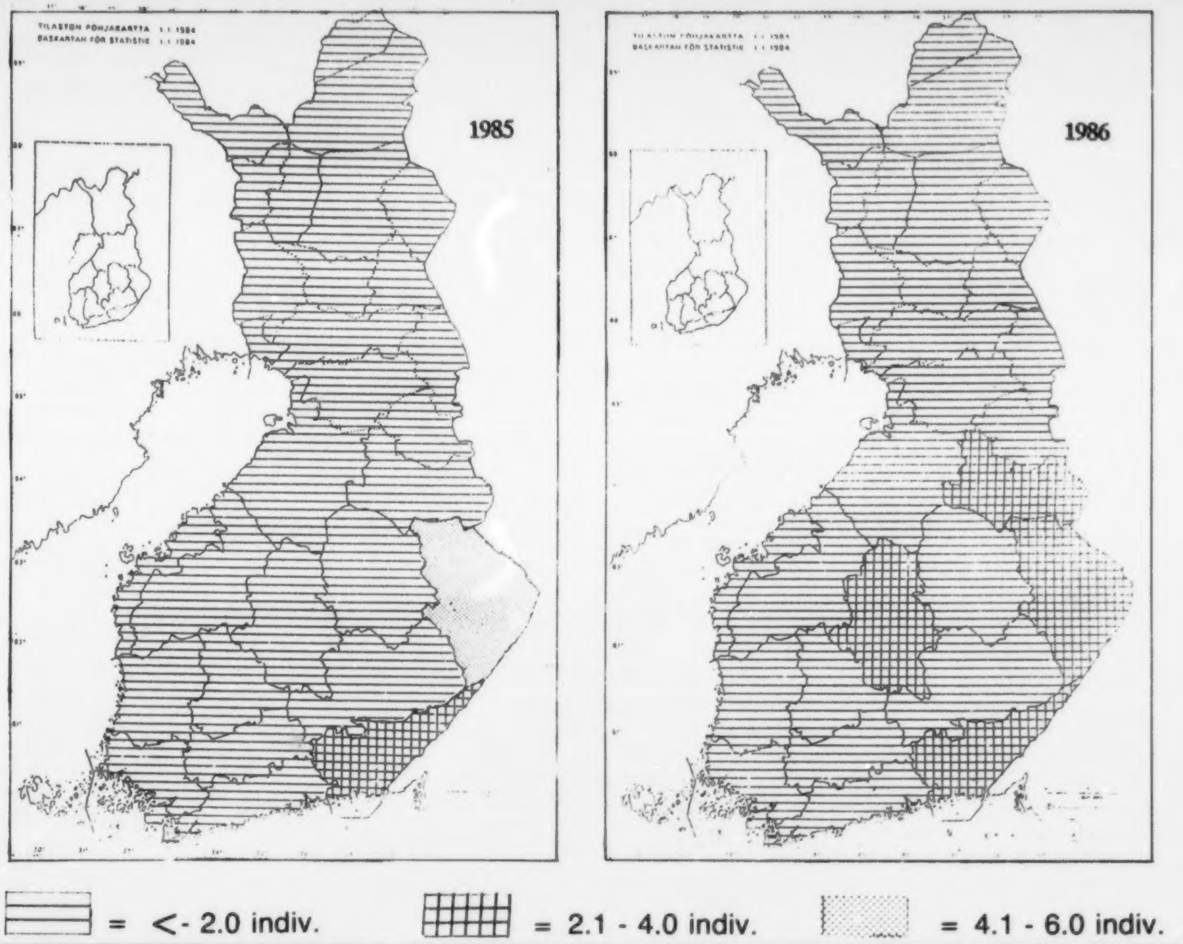

TILASTON POHJAKARTTA 1.1.1984
BASKARTAN FÖR STATISTIK 1.1.1984
1985
1986
= <- 2.0 indiv.
= 2.1 - 4.0 indiv.
= 4.1 - 6.0 indiv.

Figure 2. The density of brown bears in Finland 1985-1986 (bears/1000 km^2).

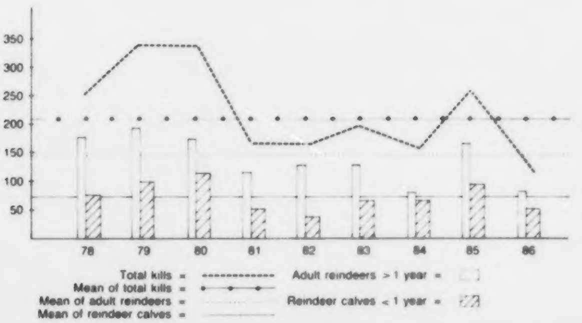


Figure 3. Reindeer killed by brown bears in Finland, 1978-1986. Numbers show kills for which compensation was approved by the government.

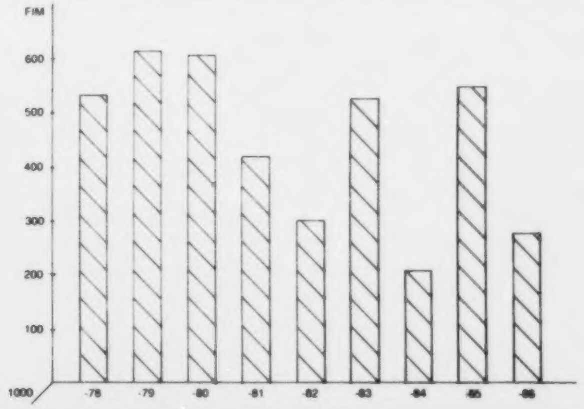
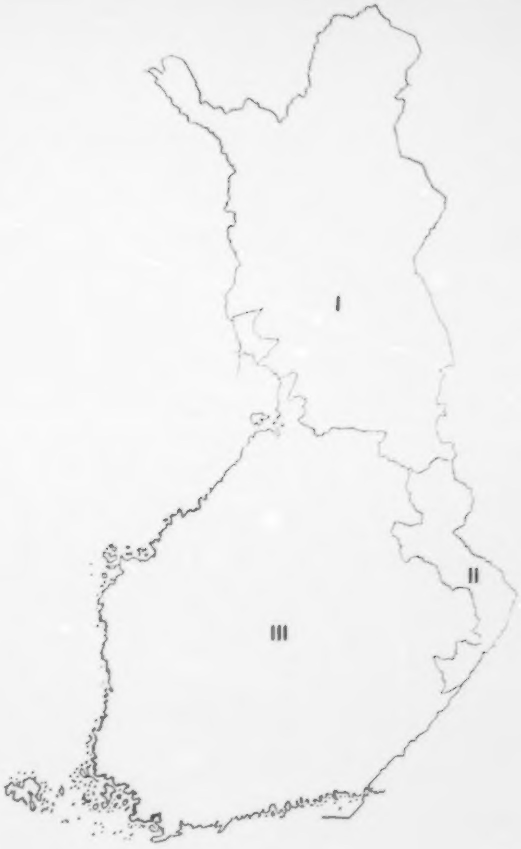


Figure 4. Compensation (Finnish Marks) for reindeer killed by brown bears in Finland, 1978-1986.



Females and cubs are protected year-round throughout the country.

I = open seasons 1 May - 15 June and
1 September - 15 October.
II = open season 1 September - 15 October.
III = protected throughout the year.

Figure 5. Hunting areas of brown bears in Finland.

In the last 5 years, the number of bear attacks has increased by 42.8% over the preceding 5 years. There is a significant different (t 0.995) in average number of attacks between the period 1976-1981 (annual $\bar{x}=0.8$) and the period 1982-1986 (annual $\bar{x}=2.0$). However, the number of attacks is negatively correlated with the fluctuating annual minimum estimated population. This change in the behaviour of brown bears in protected areas is a real concern. The first human mortality will likely occur in the near future if the problem is not managed effectively.

A bear attack can occur very quickly. For example, the results of an attack were documented with a motor-driven camera (5 shots/sec) in 1983 (Figure 6). The entire attack lasted only 2 - 4 seconds. The bear was trapped in a cage by a research team consisting of one man with a gun, a man with a dog, a photographer, and a biologist. The bear was measured and marked without the use of drugs, and given honey to calm it down. We knew that this particular adult male (200 kg) was one of 3 male bears pursuing the same female.

After the bear was marked, it broke the door of the handling cage and attacked the man with the only firearm. The bear knocked the rifle away, smashed it in one bite, and attacked the man's head. This happened in 1 second. After 2 seconds the bear had knocked the man down and bitten him on the head, neck, and hands. The victim used his hands to protect his head. The dog was released after 2 seconds. Within 4 seconds after the attack began, the 2 animals could be heard fighting some distance away. The man received numerous bites to his hands and head, and required 51 stitches to his head at the hospital.

Attacks such as this occur each year in Finland, but they are not always publicized. This is different from North America where such interactions receive much publicity (Herrero 1985).

A bear attack is not always precipitated by the direct actions of people; one can stand quite motionless and still be attacked by a female with yearlings or cubs (Svanberg 1986). Even if a person stands motionless downwind, there is a good chance that a female with cubs or yearlings will attack if the family group is within 20 - 30 m. This occurred in 54% ($N=18$) of the cases in Finland after the female observed a person. The female is acting to remove a perceived danger. The severity of the attack depends on the individual bear and the person's behaviour during the attack.

Recommendations for Avoiding Bear Attacks

One of the best ways to avoid bear attacks is to maintain a minimum distance of 40 - 50 m from the bear. In most cases, the bear is more likely to flee from a person than attack at this distance. Additional recommendations include: (1) Make noise when hiking, to let the bear know you are in the area. This reduces the chance of surprise encounters. (2) Shoot over the bear or in front of it. (3) Make a quiet retreat if possible. (4) Release a good bear dog. A good dog will actually bite the bear, and is capable of holding a bear at bay for hours or driving it away.

Figure 6a. The brown bear has just broken the wood poles of the cage (all photographs by Eero Kemilä).

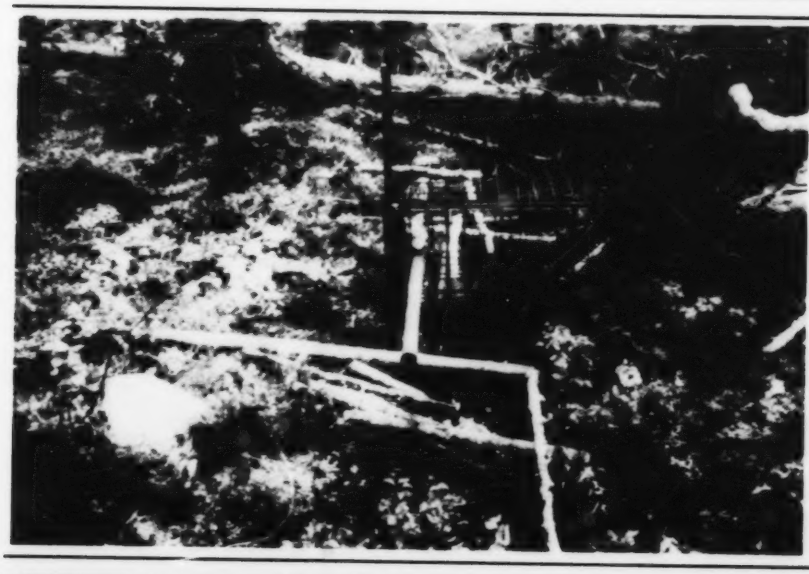


Figure 6b. 1 second: the bear has already smashed the rifle.

Figure 6c. 2.5 seconds: The Karelian beardog has been released and is attacking the bear.

Figure 6d. The dog and bear can be heard fighting about 100 m away. The dog always uses the same method: going behind the bear and biting it in the rump.

Figure 6e. Several minutes later: the dog is still working the bear and we are taking care of the patient.

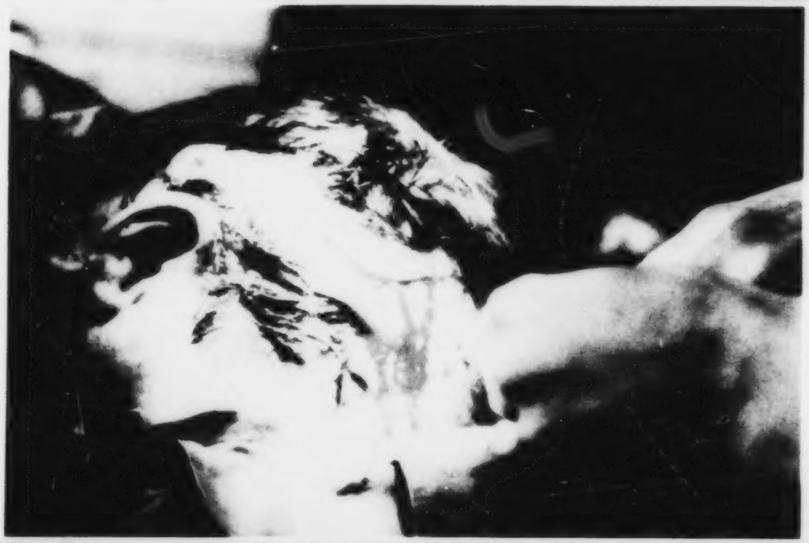


Figure 6f. The patient survived. He had very good luck thanks to the bad teeth of this old bear.

The Karelian Beardog and the East Siberian Laika proved to be the best breeds of dogs for working with bears (Nyholm 1973, 1974, 1987). Good bear dogs are quick, and do not hesitate to bite the bear. When confronted by an aggressive dog, a bear normally climbs a tree. Bear dogs are the best assistants when pursuing a wounded bear or when trying to eliminate a problem bear. However, the training of a reliable dog takes time and effort (Nyholm 1977*a*, *b*, *c*).

The Finnish public would like to see the density of the brown bear population double (Council of Nature Reserves 1986). However, there is no literature available on dealing with human-bear interactions in Finland. If the long-term plans of the Council of Nature Reserves are fulfilled, human-bear conflicts can be expected to increase (Nyholm 1986*d*). Therefore, there is need for a comprehensive education program.

LITERATURE CITED

COUNCIL OF NATURE RESERVES. 1986. The populations of the large carnivores and their management in Southern Finland. Luonnonvarain julkaisuja 10, Hki. 68 pp. (In Finnish).

HERRERO, S. 1985. Bear attacks: their causes and avoidance. Winchester Press. Piscataway, N.J. 287 pp.

NYHOLM, E.S. 1973. Hunting of the polar bear with Karelian beardogs. Jaktamarkeroch Fishevatten, Vesteras, pp. 28-32. (In Swedish).

_____. 1974. The Karelian Beardog - a dog for the big game. Karhukoira, Helsinki, pp. 7-11. (In Finnish).

_____. 1977*a*. Bear hunting with a dog - Part I: the choice of a beardog and its training. Metsästys ja Kalastus 4:10-13. (In Finnish).

_____. 1977*b*. Bear hunting with a dog - Part II: behavior of a bear in relation to the bark of a dog. Metsästys ja Kalastus 5:18-21. (In Finnish).

_____. 1977*c*. Bear hunting with a dog - Part III: an ideal bear dog. Metsästys ja Kalastus 6:18-21. (In Finnish).

_____. 1982. On the signs in the terrain, and on the prey, made by the big carnivores. Suomen elainlääkärilehti 88:569-575. (In Finnish).

_____. 1983*a*. Bear hunting is a serious thing. Metsästys ja Kalastus 11:10-13, 75. (In Finnish).

_____. 1983*b*. Accuracy during bear hunting is important. Metsästys ja Kalastus 12:20-21. (In Finnish).

_____. 1985. The bear in Finland. Pohjois-Karjalan Luonto 14 vk. 19, 22 pp. (In Finnish).

_____. 1986*a*. Behavior of the brown bear (*Ursus arctos*) on the eastern border of Finland. Manuscript of poster session in Yugoslavia. March 1986.

_____. 1986*b*. Trapping brown bears (*Ursus arctos*) and polar bears (*Ursus maritimus*) with the steel trap. Unpubl. manuscript.

_____. 1986*c*. On the sources of nourishment of the brown bear (*Ursus arctos*) in May - June period in Finland. IV Theriological Congress, Edmonton, Alberta, Canada, August 1986.

_____. 1986*d*. Wolverine, wolf, bear and lynx populations and their management in Finland. Manuscript to Government of Agriculture and Forestry. (In Finnish).

_____. 1987. Big Game in Finland. Manuscript WSOY 1987. (In Finnish).

SVANBERG, A. 1986. A bear tragedy with a happy ending. Svensk jakt 12:18-20. (In Swedish).

THE CONSEQUENCES OF PROTECTING PROBLEM GRIZZLY BEARS

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Abstract: Concern for the long-term status of the Yellowstone grizzly bear population has generated great efforts to protect and preserve grizzly bears (*Ursus arctos horribilis*), particularly adult females. A detailed examination of individual case histories suggested that these efforts led to the destruction of more bears than would have occurred if individuals were removed as soon as they were identified clearly by their behaviour as problem animals. Although public and political pressures to retain individual bears are recognized, we suggest that prompt removal of habitual offenders may enhance population welfare through recruitment of naive individuals.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Management of bears in Yellowstone National Park has evolved over the past century, with varying degrees of tolerance by humans for problem or nuisance bears, countered by relocation or removal of offending individuals. Relocation as an alternative to removal became an operational management option perhaps 60 years ago (Schullery 1986); use of relocation increased thereafter with refinement of techniques and equipment.

After 1962, management procedures were influenced increasingly by concern for the grizzly bear as a rare species (Cole 1972). Removal of particular individuals was deferred, primarily by use of relocation. Cole (1972) noted that deferred removals resulted in family groups frequenting certain developed areas and contributed to the numbers of grizzly bears which had to be destroyed. From 1971-1980 deferments were few as garbage dumps were closed, incorrigible bears were removed, and the need for management actions decreased (Meagher and Phillips 1983).

After the grizzly bear population that centers on the park was listed officially as threatened in 1975, management and public concern intensified. An Interagency Grizzly Bear Committee was formed in 1983, and a recovery plan (U.S. Fish and Wildl. Serv., In Press) and interagency guidelines were written (Interagency Grizzly Bear Committee 1986). Knight and Eberhardt (1984, 1985) developed a model which suggested a population decline; the model also suggested that stability might hinge on the presence in the population of 1 or 2 additional adult female bears. As a result, the welfare and continued existence of the grizzly bear in the Yellowstone area was perceived as a function of the preservation of individual bears, particularly females. After 1980 deferred removals increased. We present management case histories of known individuals to further evaluate deferred removals of problem bears as a biologically useful management option for a threatened population.

We thank K. Kendall and C. Servheen for helpful reviews of the manuscript. E. Gresswell and M. Laubach typed the manuscript.

METHODS

Records from the centralized bear monitoring system maintained in Yellowstone National Park (Meagher and Phillips 1983) were used for this evaluation. The record system was expanded in 1981 to include all known grizzly bear histories within and outside the park boundaries. Records maintained for all individually identified bears included instances of handling for research purposes, management actions (relocations and removals), radio locations, visual observations, bear-human interactions, family relationships when known, and final outcome or fate of the bear, when known. The accumulated information on individuals which indicated need for management action is not presented in this paper, but these records are on file permanently and are available to any interested reader.

We reviewed all records for known adult and subadult female grizzly bears handled in management actions from 1981-1986; these we called primary bears because of their active or potential role in reproduction. We traced their histories, and those of their known offspring

TABLE 1. Management case histories of female grizzly bears and their offspring, Yellowstone National Park area, 1981-1986[a].

BEAR GENERATIONS[b]									
Primary	Secondary		Year						
1st	2nd	3rd	1981	1982	1983	1984	1985	1986	Future
8 (F/15)			← R R	X					
	67 (F/cub)		R R	R	R R	R R	X		
	74 (M/cub)		R R R	P	?	?	?	?	?UP
	49 (M/2)		← XI						
	81 (M/2)		← R R	R R X					
10 (F/11)			← P	R	X				
	93 (F/cub)			R	R	X			
	94 (M/cub)			R	R X				
	95 (M/cub)			R	R R X				
	69 (F/1)		← R	X					
	90 (M/1)		← R	R X					
26 (F/22)	101 (F/1)		← R R XI						
38 (F/12)			← P	P	R	XA			
	101 (F/1)				R	?	?	P	XM
	102 (F/1)				R	XS			
50 (F/7)			← R	P	P	R	DM	R R R	XM
	cub			XN					
	cub-may have been			P	?	?	?	?	?UP
	120; if so:					R R R	XI		
	127 (M/1)							R R X	
	128 (F/1)							R	XM
59 (F/3)			← R	DM	DM	DM	DM	R X	
	2 cubs					P	XN		
	2 cubs							P	?
60 (F/4)			← R	R	X				
	cub (F)				R	?	?	?	?UP
	cub (F)				XA				
77 (F/9)			R XU						
	75 (F/1)		R	?	?	?	?	?	?UP
	76 (F/1)		R	P	P	?	?	R XI	
		cub (F)						R XI	
		cub (F)						R X	
79 (F/13)			R	?	?	?	?	R R	XM
	80 (M/1)		R	?	?	?	?	?	?UP
	cub (F)							R	XM
	cub (F)							R	XM
82 (F/5)			R	?	?	?	?	?	?UP
83 (F/13)			R R	DM	P	?	?	R	XM
	113 (M/2)					R R X			
	114 (F/2)					R	R R	DM	XM
	cub							XN	
	cub							R	XM
116 (F/10)						R	P	R R	XM
	Yrlg (M)					XA			
	117 (F/1)					R	P	?	XM
	118 (F/1)					R	P	DM	XM
	cub (F)							R R	XM
	cub (F)							R R	XM
	cub (F)							R R	XM
119 (F/3)						R	P	?	XM
122 (F/4)								R R XI	
130 (F/4)								R	XM
134 (F/6)								R	XM
TOTAL									
16	36	2							

[a] Includes: P = bear present; ? = status unknown; ← = bear handled for research or management prior to 1981; R = relocation; DM = management action deferred; X = management removal; XA = accidental mortality; XI = illegal kill; XN = natural mortality; XS = suspected mortality; XU = unknown cause of mortality; XM = mortality probable by accident, illegal kill, or management decision; and ?UP = unlikely present.

[b] Generation indicates family relationship. Bears with radio collars are identified by number. Sex and age are indicated for first management handling.

which we termed secondary bears, to assess whether or not relocations or management removals were deferred. "Deferred" is used here when rehabilitation was attempted beyond the specifics of agreed-upon interagency guidelines for handling nuisance bears (Interagency Grizzly Bear Committee 1986:57) and beyond the point at which experience indicated management removal should occur. The guideline specifics allow for 0 to 2 relocations in the bear's history; the circumstances of the problem and the bear's behaviour are considered. Deferred management removal during the years 1981-1986 included 3 categories: delay in relocation effort by not addressing the problem, experiments with aversive conditioning techniques as a substitute for relocation; and repetitive relocations prior to removal. An assessment of probable future removal (management or illegal kill) was derived from relocation history, demonstrated unnatural aggressive or habituated behaviour toward human presence, and known frequenting of developments and use of human foods. In the case histories, the term "removal" is used to indicate the bear is no longer in the population. Removals included bears sent to zoos or released in a different population far removed from the Yellowstone area, and mortality from all causes.

RESULTS AND DISCUSSION

Management efforts to keep problem grizzly bears in the Yellowstone population generally were unsuccessful when analyzed for 6 consecutive years (Table 1). Of the 54 bears (Table 1) whose records we reviewed, 30 are gone from the population, 7 are unlikely to be present, and 17 appeared unlikely to have a non-problem-bear future. Thirteen of the 16 primary females were first handled before 1986; 7 of these 13 were gone by the end of 1986 (nos. 8, 10, 26, 38, 59, 60, 77). Of the other 6, 1 is probably gone (no. 82), and 4 have been handled repeatedly and will probably be removed (nos. 50, 79, 83, 116). The sixth (no. 119) is probably present; her future is discussed below. Bear 122, first handled in 1986, was apparently killed illegally in the fall. Although 3 of the 16 primary females (nos. 119, 130, 134) might have some possibility of remaining in the Yellowstone population, their future is unpromising. Bears 119 and 130 are linked to apple orchards and a boundary town area, respectively. Bear 134 is habituated to human presence.

Eleven of the 16 primary female grizzly bears were known to have produced 38 offspring (secondary bears) either directly or as grandmothers (Table 1). Twenty-one of the 38 secondary bears are gone, and 5 will probably be removed. The remaining 12 appear to have an unlikely future: 5 are probably not now present in the population, and the 2 cubs abandoned by bear 59 may not survive. Of the remaining 5, bear 101 may have learned to kill domestic sheep. Bears 117 and 128 likely will be a problem in a boundary town area; the 2 cubs of bear 79 may be linked to apples.

Most of these 54 grizzlies were classified as problem bears because they became linked to human food sources, primarily garbage and groceries, and frequented developments. The few exceptions used other human foods, such as domestic sheep (no. 38) or apples (nos. 26, 77, 79) in proximity to developments or human activities and returned repeatedly to these food sources. Some bears were habituated to and tolerant of human presence prior to obtaining human foods (nos. 59, 122) and included developed areas and vicinities within their home ranges (all primary bears). Bears 8, 10, 26, 38, 50 and 60 were first captured as research bears. Their use of geographic areas that included small towns adjacent to the park boundary facilitated capture for research purposes, but probably increased the likelihood that they would become problem bears.

The case histories showed that apparent success in prolonging the survival of primary female grizzly bears by relocation was achieved for several years for bears 50, 79, and 83. However, over time that success was not substantiated. These bears again became problems, and will probably be removed. None of these females are known to have contributed non-problem offspring to the population in the interim. Relocation efforts with other family groups (Table 1) also did not appear successful in contributing non-problem offspring. These results suggested that bears learned food sources and foraging areas when very young, by accompanying their mothers, and that these learned behavioural traits persisted. Offspring of problem mothers either become problem bears, or appeared likely to be killed illegally.

An additional problem female (no. 104) was not shown on Table 1, because she was not relocated. She is habituated to human activity, and has probably obtained human foods. Aversive conditioning was subsequently attempted, but was apparently unsuccessful. We would categorize her and her 2 cubs as deferred removals.

We conclude that deferred removal of grizzly bears which are habitual offenders does not promise success as a biologically useful management option in Yellowstone National Park. Further, it is apparent that more bears were removed eventually because offspring were produced that also became problem bears. These offspring would not have been produced if these female grizzly bears had been removed earlier. We suggest that prompt removal of problem female grizzly bears, and offspring when present, might result in use of available habitat by non-problem young bears. This, in turn, might facilitate their recruitment into the population.

LITERATURE CITED

COLE, G. F. 1972. Preservation and management of grizzly bears in Yellowstone National Park. Int. Conf. Bear Res. and Manage. 2:274-288.

INTERAGENCY GRIZZLY BEAR COMMITTEE. 1986. Interagency grizzly bear guidelines. Grizzly Bear Recovery Coordinator. U.S. Fish and Wildl. Serv. 99 pp.

KNIGHT, R. R., and L. L. EBERHARDT. 1984. Projected future abundance of the Yellowstone grizzly bear. J. Wildl. Manage. 48:1434-1437.

_____ and _____. 1985. Population dynamics of Yellowstone grizzly bears. Ecology 66:323-334.

MEAGHER, M., and J. R. PHILLIPS. 1983. Restoration of natural populations of grizzly and black bears in Yellowstone National Park. Int. Conf. Bear Res. and Manage. 5:152-158.

SCHULLERY, P. 1986. The bears of Yellowstone. Rev. ed. Roberts Rinehart Inc., Boulder, Co. 263 pp.

U.S. FISH AND WILDLIFE SERVICE. In Press. Grizzly bear recovery plan. Revised. Grizzly Bear Recovery Coordinator. U.S. Fish and Wildl. Serv.

EFFECTIVENESS OF HUMAN-BEAR MANAGEMENT AT PROTECTING VISITORS AND PROPERTY IN YOSEMITE NATIONAL PARK

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Abstract: Yosemite National Park initiated an intensive Human/Bear Management Program in 1975 to restore the natural abundance, behaviour and ecological integrity of the black bear (*Ursus americanus*) population, and provide for the safety of visitors and their property. The program included (1) public information and education, (2) removal of artificial food sources, (3) law enforcement, (4) control of problem bears, and (5) research and monitoring. There was a significant reduction in property damage incidents during the 12-year reporting period in 4 of 5 front-country management subdistricts. There was no significant decrease in property damage incidents in the back-country or Wawona front-country subdistricts. The number of personal injuries declined significantly throughout the park. The program was most successful where all 5 program elements were fully implemented. Public information messages must be strongly worded and motivating to be effective. Strict law enforcement may be an alternative motivational method. Food and refuse storage facilities must be easy to use, readily available, and effective. Bears presented with gradually reduced availability of food developed more sophisticated behaviours that permitted access to human foods during the study. Removal of such animals may be necessary.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Black bears in Yosemite National Park have used food provided intentionally and unintentionally by humans since the 1920's. This relationship between bears and humans over a period of 60 years led to serious conflicts including personal injury and property damage (Harms 1977). It also led to alterations in the natural behaviour (Hastings et al. 1981), foraging habits (Graber and White 1983), reproductive rates, physical size, distribution, and population levels of bears in the park (Harms 1977, Graber 1982).

In 1975 the National Park Service initiated an intensive Human/Bear Management Program in Yosemite (Harms 1977). The objectives of this program were to (1) restore and maintain the natural distribution, abundance, and behaviour of the endemic black bear population, (2) provide for the safety of park visitors and their property, and (3) provide opportunities for visitors to understand, observe, and appreciate the black bear in its natural habitat.

To achieve the stated objectives, the park initiated a program consisting of 5 basic elements: (1) public information and education, (2) removal of artificial food sources, (3) enforcement of regulations regarding proper food storage and feeding of wild animals, (4) control of problem bears, and (5) research and monitoring.

Public information and education consisted of specially designed brochures, warning signs, interpretive programs, a taped AM radio message, and beginning in 1985 a 16mm movie. The movie, "Forever Wild", described black bear ecology, identified the cause of bear-people conflicts, and described the Human/Bear Management Program. The movie graphically portrayed the impact of improper visitor behaviour which ultimately resulted in a bear's death.

Removal of artificial food sources began with the closing of open pit garbage dumps by 1971 and bear-proofing garbage receptacles by 1975. Refuse containers were not bear-proofed in Wawona within the 2.56 km^2 of private inholdings. Steel food storage lockers were installed in 1 back-country camp and 4 front-country campgrounds from 1977-1985. Food suspension cables and food storage poles were installed in selected back-country areas and front-country walk-in campgrounds.

A special regulation was adopted that required proper food storage methods. Enforcement of this and previous regulations against feeding and harassing wildlife was conducted at the lowest level necessary to achieve visitor compliance.

Each capture and/or destruction of a bear was recorded as a control action. Bears captured in the front-country were translocated 15 - 50 km to 1 of 7 predetermined release sites (U.S. Dept. of the Inter. 1982), all within the park in good bear habitat. The front-country capture/translocation effort was intensive, with the goal of removing bears from developed areas before they received a food reward (Stokes 1970). Beginning in 1980 bears in Wawona were captured and tagged but not translocated unless they caused extensive property damage. This policy was based on the assumption that adult males provide population stability and may exclude other bears (Kemp 1976), so fewer bears would become conditioned. Bears were not translocated from back-country areas.

The program began with a policy of killing bears captured 3 times that were confirmed problem animals or were responsible for personal injuries (Harms 1977). By 1978, the policy shifted to a case by case evaluation of documented behaviour patterns, captures, translocations and property damage. Criteria for killing bears in back-country areas were based solely on the threat to visitor safety. Black bears were considered a threat to humans when they repeatedly bluff-charged visitors at close distances, approached visitors regularly to within a few metres near precipitous cliffs, entered occupied dwellings, or exhibited other behaviour that indicated a high potential for accidental or intentional injury.

This study evaluated the effectiveness of the Human/Bear Management Program at providing safety for park visitors and their property. We also evaluated the effectiveness of some public information and education techniques.

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STUDY AREA

Yosemite National Park (Figure 1) encompasses 308,000 ha on the west slope of the Sierra Nevada Mountains in central California. Elevations vary from 600 m on the western boundary to 4,000 m on the crest. The climate is Mediterranean with hot, dry summers and cool, moist winters. The roadless back-country of the park covers 277,000 ha.

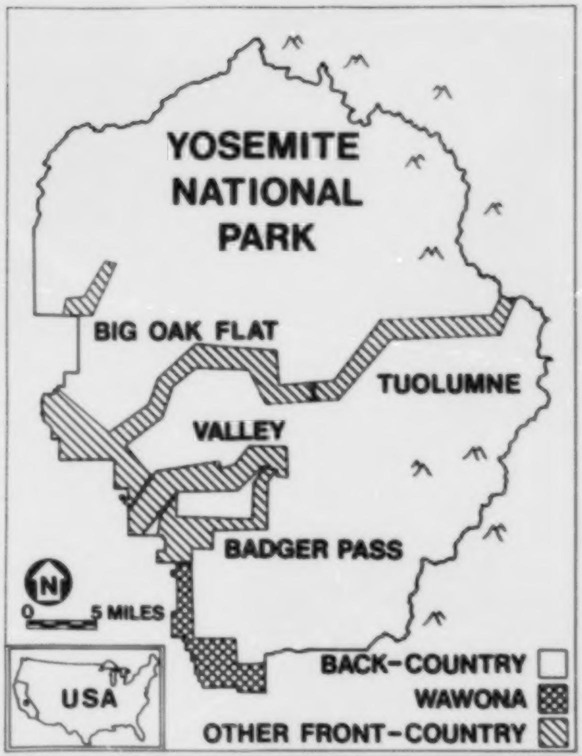

Figure 1. Districts, subdistricts, and black bear management units, Yosemite National Park, California.

The vegetation of Yosemite can be described by 4 major types (Barbour and Major 1977). A limited amount of chaparral (7,000 ha), consisting of oaks (*Quercus* spp.), manzanita (*Arctostaphylos* spp.), and ceanothus (*Ceanothus* spp.), exists at the lower elevations. The mixed conifer type occupies 65,000 ha between 1,300 m and 2,000 m. The most prevalent species in this type are ponderosa pine (*Pinus ponderosa*), incense cedar (*Calocedrus decurrens*), and California black oak (*Q. kelloggii*). The 70,000 ha red fir (*Abies magnifica*) type is found between the mixed conifer type and 2,700 m elevation. The lodgepole pine (*P. contorta*) subalpine type extends to 3,300 m and covers 122,000 ha of the park. The remaining 44,000 ha are above timberline.

Historically, black bears inhabited the chaparral and mixed conifer types and were only rarely seen above 2,500 m (Grinnell and Storer 1924). In recent years, however, they were commonly sighted at 3,100 m in the subalpine type. Bear incidents occurred throughout 75% of the park's back-country (Keay and van Wagtendonk 1983) and all of the front-country areas.

Yosemite National Park averaged over 2.6 million visitors per year for the past 15 years (1970-1985). Back-country use averaged 62,255 visitors per year from 1976 to 1985. These visitors spent an average of slightly less than 3 nights in the back-country and nearly 146,493 visitor-nights per year. The 100-day summer season between Memorial Day and Labor Day accounts for 68% of the back-country use, with August being the peak month (van Wagtendonk 1981).

The park is divided into 6 management districts or subdistricts (Table 1, Figure 1). The back-country district includes all areas of the park over 5 km from a public road. The Valley district receives 90% of the annual park visitation. The Tioga Pass road to Tuolumne Meadows usually opened the last weekend in May and closed with the first heavy snowstorm in November. The Yosemite Valley and Wawona subdistricts provided year-round visitor accommodations.

Table 1. Visitor and employee accommodations, elevation, and area of management districts or subdistricts, Yosemite National Park, California.

		-----Front-country units[a]----				
	BC	Vall	BOF	Tuol	Badg	Wawo
Hotels/Motels	0	2	0	0	0	1
Tent Cabins	84	1018	48	155	2	4
Permanent Residences	0	165	30	10	5	400
Campgrounds	0	7	6	2	1	1
Campsites	0[b]	825	502	375	110	100
Picnic Areas	1	4	1	0	0	0
Trailhead Parking	0	3	5	8	5	1
Elevation (m)	600-4000	1200	1200-2450	2450-3050	1800-2450	1500
Area (x1000ha)	277	5	11	6	4	5

[a] BC = Back-country Subdistrict, Vall = Valley District, BOF = Big Oak Flat Subdistrict, Tuol = Tuolumne Meadows Subdistrict, Badg = Badger Pass Subdistrict, Wawo = Wawona Subdistrict.

[b] There are no designated campsites in Yosemite's back-country.

METHODS

Bear Incident Reports

The Resources Management Division coordinated a central monitoring system for bear incidents (defined as personal injuries or property damage) which provided the basis for this study. Bear incident reports documented date, time, location, description and tag information for the bear(s) involved, nature of the incident, type of property damaged and estimated cost, whether food was obtained, reason for the incident, type of bear information received by the victim, type of victim, and the victim's name and address.

Victims were classified as visitors or residents. Visitors were those people in the park for short recreational visits that may not have been familiar with the bear problem when they arrived. Residents included National Park Service and concessioner employees, inholders, and contractors. They should have understood the significance of the problem and been motivated to assist in its solution.

The type of information received by victims prior to the bear incident was summarized into 6 categories: brochures, personal contact with an employee, interpretive programs, signs, radio message, or none received.

Each bear incident report included the type of area in which the incident occurred. Coded locations included off trails, on or near trails, roadsides, picnic areas, parking lots, campgrounds, businesses, permanent residences, and tent camps. Roadsides and picnic areas were not considered for this analysis because they only made up 0.5% and 0.1% of the total reported incidents.

Each report also included information on the type of property damaged, and the estimated cost of the damage. The 7 categories of objects were tent, pack/foodsack, food/other, ice chest, building, motor vehicle, and towed unit. More than one object could have been reported damaged for each incident.

A park wildlife biologist coded each bear incident for the apparent reason it occurred. Potential reasons included (1) unknown, (2) feeding, baiting or harassing, (3) food left unguarded, (4) improperly disposed garbage, (5) improperly stored food, (6) accidental encounter, (7) conditioned bear behaviour, and (8) other. For analysis purposes the data were grouped into 3 categories: victim mistake, conditioned bear behaviour, and accidental encounter, or other.

If the Human/Bear Management Program was successful at protecting humans and their property, we would expect a reduction in the number of bear incidents in each management area, a reduction in the total cost of property damaged, and a reduction in the number of personal injuries over the 12 years of the program.

Data Analysis

Bear incident reports for 1975-1982 were summarized from edited computerized records. Data for 1983-1986 were hand-tabulated. Chi-square tests for heterogeneity were used to determine similarity or differences between management units or years. More than 1 response per incident was possible for the type of information received and the type of property damaged. For each of these variables, a 1 x K Chi-square was used to identify significant differences between management units. The expected value was based on the proportion of total incidents that occurred in that subdistrict. Simple linear regression was used to test for trends in the number or proportion of incidents of a given type over time. Sample sizes for regressions were 1 data point for each of the 12 years of the program unless otherwise stated. Student's t statistic was used to determine if the slope of the regression line was significantly different from zero. All statistical tests were run using SPSSPC (Norusis 1984), except the 1 x K Chi-square tests which were done on a programmable calculator. Differences were considered significant when observed probabilities exceeded 0.05. Sample sizes varied between tests because all reports did not contain information on all variables. Simple correlation coefficients (r) are not presented with results because regressions were not intended for use as predictive models. Variability of data about the predicted line is captured in the variance term used to calculate t and which indicates the significance of the relationship.

RESULTS AND DISCUSSION

Property Damage

Tests of heterogeneity indicated no differences between 4 of the subdistricts for most variables considered. Consequently, data are presented for (1) the back-country, (2) Wawona, and (3) other front-country management units.

Number of bear incidents • Regression analysis indicated no increasing or decreasing trend ($b = -0.09$, $\hat{p} = 0.991$, $n = 12$) in the number of reported back-country bear incidents since the program began. Reporting rates of back-country bear incidents increased in 1976 and were felt to be stable through the remainder of the reporting period. Without the underrepresented 1975 data there was still no trend in back-country bear incidents ($b = -7.35$, $\hat{p} = 0.4055$, $n = 11$). Back-country incidents totalled 2,837 (Table 2) and averaged 236 annually from 1975 through 1986. These figures represented 8 - 11% of the actual number of incidents that occurred (B.C. Hastings, Univ. Tenn. unpubl. data; J.W. van Wagtendonk, Yosemite Natl. Park unpubl. data). Damages were estimated at $105,483 with an average cost of $37 per back-country incident.

Table 2. Number of reported black bear incidents (including injuries) by management unit, Yosemite National Park, California, 1975-1986.

Year	Back-country	Wawona	Front-country[a]	TOTAL
1975	104	13	884	1001
1976	175	5	537	717
1977	364	14	210	588
1978	286	1	232	519
1979	231	1	165	397
1980	267	6	68	341
1981	171	3	32	206
1982	427	33	207	667
1983	261	8	116	385
1984	230	8	144	382
1985	134	61	71	266
1986	187	9	97	293
TOTAL	2837	162	2763	5762

[a] Front-country subtotal includes Yosemite Valley, Big Oak Flat, Tuolumne Meadows and Badger Pass subdistricts.

Similarly, no increasing or decreasing trend could be detected in the number of reported bear incidents in Wawona ($b = 1.91$, $\hat{p} = 0.1985$, $n = 12$). The 162 reported incidents totalled $17,436 in property damage, and averaged $108 per incident, over the 12-year reporting period.

Trends in the number of reported bear incidents were similar in the remaining 4 front-country subdistricts. A large decreasing trend ($b = -48.26$, $\hat{p} = 0.0093$, $n = 12$) in the number of incidents was documented for the combined data. Interestingly, without including data from the first 2 years of the program, no increasing or decreasing trend ($b = -11.70$, $\hat{p} = 0.1258$, $n = 10$) could be detected. The 2,763 reported incidents over the 12-year period resulted in $320,943 in estimated property damage, and averaged $116 per incident. Seventy-three percent of the reported bear incidents in other front-country units occurred during the first 5 years (42%) of the program.

Type of victim • The proportion of victim types was significantly different among the 3 management units being reported ($p = 0.0000$, $n = 5{,}754$). Visitors reported 98% of the 2,833 back-country bear incidents. In Wawona, 65% of 162 incidents were reported by residents, primarily inholders. Visitors reported 95% of the 2,759 bear incidents in the other front-country subdistricts where type of victim was recorded.

Type of information received by victims • Data were combined for all years because of the large number of Chi-square cells with small expected values and the apparent lack of trend in each category with time.

The proportion of victims that reported receiving brochures differed among the 3 management units ($p < 0.001$, $n = 2{,}054$). Back-country victims received more than expected ($p < 0.001$, $n = 1{,}551$), while Wawona and the other front-country subdistricts received fewer than expected ($p < 0.001$, $n = 19$ and 484, respectively). Ninety percent of back-country victims, 21% of the Wawona victims, and 60% of the other front-country victims received a brochure.

Differences ($p < 0.001$, $n = 1{,}473$) also occurred among subdistricts in the proportion of victims that reported personal contacts with park personnel. Back-country and Wawona victims reported more personal contacts than expected ($p < 0.001$, $n = 1{,}101$ and 73, respectively), and the other front-country subdistricts had fewer ($p < 0.001$, $n = 299$). Personal contacts were reported by 64% of the back-country victims, 80% of the Wawona victims, and 37% of the other front-country victims.

A high percentage of back-country victims received brochures because they were stapled to the required wilderness permit for back-country camping. Most back-country campers picked up their permits in person at one of the many permit kiosks in the park, thus the high proportion of personal contacts with park personnel. Each back-country camper was given a message about bears when obtaining the permit. Back-country day users were not required to obtain permits.

Front-country campers probably did not get brochures if they arrived late, after registration kiosks closed, or went to a self-registration campground. Brochures were not available to day users or visitors staying in rental units. Concessioner employees did not regularly give a message about bears when guests checked into rental units.

It is very difficult to evaluate the effectiveness of an information medium without a measure of the number of visitors that received information from that source and did not have property damaged by bears. However, when the proportion of reporting victims that received information from a specific medium is extremely high or low, some general conclusions can be drawn.

In spite of the fact that 90% of all reporting back-country victims received the brochure, and 64% had personal contact with a National Park Service employee that discussed the bear situation with them, the number of incidents in the back-country has not decreased in the past 12 years. Back-country visitors were asked to store their food using a fairly complicated method. The method consisted of counterbalancing 2 equally weighted foodsacks over the tip of a live, down-sloping branch that was large in diameter at its base and at least 6 m off the ground. This method used no tie-off ropes that a bear could break. The most common problems were that visitors failed to select the proper branch or hung their food too close to the trunk of the tree and within reach of the bear (Keay, unpubl. data). Both of these situations were clearly explained in pictures and words in the printed back-country brochure. We conclude that these information sources did not sufficiently motivate back-country campers to either study the brochure's contents carefully or follow its instructions.

Simply informing visitors about problems and potential solutions does not appear to be an adequate means of reducing conflicts with bears. Visitors must be both motivated and provided simple and easily used techniques for making food unaccessible to bears. We have been pursuing the development of a portable bear proof food container, in conjunction with Sequoia, Kings Canyon, and Denali National Parks. Each would weigh less than 1.5 kgs and carry enough food for 3 days. They would fit inside a backpack and be carried with the food securely stored inside. Food storage poles, installed at 4 High Sierra Camps, also appear to be an effective yet simple procedure for food storage resulting in greater compliance than food counterbalanced in trees or on food suspension cables (Keay, unpubl. data).

There was a difference ($p < 0.01$, $n = 226$) in the proportion of victims in each management unit who reported going to interpretive programs. More Wawona victims attended interpretive programs than expected ($p < 0.005$, $n = 14$), whereas back-country and front-country victims' attendance at interpretive programs was as expected ($p > 0.75$, $n = 114$ and $p > 0.25$, $n = 98$, respectively). Interpretive programs were attended by

7% of the back-country, 15% of the Wawona, and 1% of the other front-country victims.

The low percentage of victims who had attended interpretive programs suggests that either the programs were very effective at educating and motivating potential victims, or proportionately very few people attended them. Back-country users generally spent little time in the front-country areas so likely didn't attend many interpretive programs. A high proportion of residents in Wawona probably attended programs some time during their stay in Yosemite, thus explaining the higher than expected proportion reported in bear incidents. The park estimated that over 291,000 visitors (10% of the annual front- country visitation) were reached through interpretive programs in 1985. Since 95% of the other front-country subdistrict victims were visitors, and only 1% of them attended interpretive programs, it seems that programs may be an effective method of educating and motivating the public. Preliminary tests indicated a statistically significant difference would not be detected.

Among the 3 management units, there was a difference ($p < 0.001$, $n = 938$) in the proportion of victims who read warning signs about bears. More back-country users read signs than expected ($p < 0.001$, $n = 538$), whereas fewer Wawona ($p < 0.05$, $n = 15$) and other front-country victims ($p < 0.005$, $n = 385$) read signs. Signs were read by 31% of the back-country victims, 16% of the Wawona victims, and 48% of the other front-country victims. Evaluation of the effectiveness of signs as an information medium was not possible. Signs play a significant role in follow-up law enforcement actions and protection from law suits, as well as being a source of public information. Therefore, an effective sign program for visitors to all park areas seems necessary.

There was no difference ($p > 0.1$, $n = 76$) in the number of victims who heard the radio message in the different management units. Only 3% of the victims reported hearing it. Either the message was extremely effective or very few park visitors listened to it. The radio frequency assigned by the U.S. Federal Communications Commission was not receivable by many commercial automobile radios. Thus, we suspect the latter.

There was a difference ($p < 0.001$, $n = 124$) among the 3 management units in the proportion of victims who received no information at all. Fewer ($p < 0.001$, $n = 32$) back-country victims received no information, and more ($p < 0.001$, $n = 86$) victims from the other front-country subdistricts received no information than would be expected. Wawona victims received no information in equal proportion to expected ($p > 0.25$, $n = 6$). No information was received by 2% of the back-country, 7% of the Wawona, and 11% of the other front-country victims. These low percentages indicated we were reaching the potential victims with some type of information. Apparently we must make the message either more informative, more motivating, or both.

Location of bear incidents • Significant differences occurred in the location of bear incidents among the 3 management areas considered ($p = 0.0000$, $n = 5{,}703$).

Back-country bear incidents occurred primarily (65%, $n = 2{,}825$) in regularly used camp areas. Incidents along or near trails accounted for 27% of the reports, and off-trail incidents totalled 8%. Differences ($p = 0.0000$, $n = 2{,}817$) in the proportion of incidents reported in the 3 types of location occurred among years. The differences were shifts between incidents occurring in camp areas and on or near trails. No increasing or decreasing trends were detected in the number of reported back-country incidents in camp areas ($b = 1.15$, $p = 0.8676$, $n = 12$), on or near trails ($b = -2.12$, $p = 0.6478$, $n = 12$) or off trails ($b = 0.90$, $p = 0.6133$, $n = 12$) through the reporting period.

In Wawona, 69% of 159 incidents occurred at residences. The rest were divided among campgrounds (16%), businesses (7%), parking lots (6%), and tent cabins (3%). No significant increase or decrease ($b = 2.07$, $p = 0.1004$, $n = 12$) in incidents occurred for residences. A decreasing trend ($b = -0.63$, $p = 0.028$, $n = 12$) was detected in the number of campground incidents. Twenty-one of the 25 camp-ground incidents occurred in the first 4 years of the program, during the period when bears were trans-located from Wawona. The activity patterns of the resident nuisance bears revolve around access to traditional garbage cans near the residences. If the cessation of translocations helped stabilize the population, the consistent behaviour patterns of individual bears may have restricted the location of bear incidents through the remainder of the reporting period.

Incidents in other front-country subdistricts occurred primarily in campgrounds (67%, $n = 2{,}719$) and parking lots (25%). There were decreasing trends in the number of incidents reported for parking lots ($b = -15.8$, $p = 0.0027$, $n = 12$) and campgrounds ($b = -30.0$, $p = 0.0134$, $n = 12$) over time, but an increase in the proportion of incidents that occurred in campgrounds ($b = 2.4$, $p = 0.0148$, $n = 12$). Over 80% of the reported front-country incidents (not including Wawona) in the past 2 years occurred in campgrounds. Removal of artificial food sources and visitor information efforts in the front-country should focus on campgrounds and campers. Food storage lockers were installed in every front-country campsite in the park, except 3 campgrounds in Yosemite Valley, during 1987 and 1988.

Object damaged • Differences ($p < 0.001$, $n = 288$) were detected in the proportion of tents damaged in the 3 management units. Fewer ($p < 0.001$, $n = 74$) tents were damaged in back-country areas, and more ($p < 0.001$, $n = 205$) were damaged in other front-country subdistricts than expected. The proportions of tents damaged in Wawona did not differ from the expected ($p > 0.25$, $n = 9$). Tent damage occurred in 3% of back-country, 6% of Wawona and 7% of the other front-country incidents.

There was a difference ($p < 0.001$, $n = 2{,}687$) in the proportion of packs/foodsacks damaged in the different management units. The back-country had more ($p < 0.001$, $n = 2{,}367$) packs/foodsacks damaged per incident, and Wawona and the other front-country units had fewer ($p < 0.001$, $n = 5$ and 315, respectively) damaged than expected. In the back-country, 84% of the incidents included damage to packs or foodsacks, while 3% and 12% of the incidents in Wawona and the other front-country subdistricts had similar damage reported.

The proportion of food/other damage reported was different ($p < 0.001$, $n = 1{,}993$) among the 3 management units. The back-country reported more ($p < 0.001$, $n = 1{,}313$) food/other damage, and the other front-country subdistricts had less ($p < 0.001$, $n = 614$) food/other damage than expected. Reported damage in the food/other category in Wawona was not different ($p > 0.1$, $n = 66$) from the expected. In the back- country 47% of the incidents included damage in the food/other category; 42% and 22% were reported for Wawona and the other front-country subdistricts, respectively.

No increase or decrease ($b = -4.78$, $p = 0.4993$, $n = 12$) in the number of reported back-country incidents in the packs/foodsacks category could be detected over the 12-year reporting period. There was an increase ($b = 19.28$, $p = 0.0233$, $n = 12$) in the number of incidents that recorded damage in the food/other category. The rate of incident reporting in the back-country increased notably in 1976 and was felt to have stabilized since then. If 1975 incidents are removed from the regression analysis, then neither packs/foodsacks nor food/other categories show significant relationships ($b = -11.68$, $p = 0.1129$ and $b = 19.31$, $p = 0.0528$, respectively) over time.

Back-country users typically stored food in stuffsacks, suspended in trees from a rope. Bears entered the camp areas in search of food and directed attention to the suspended items. Attempts to obtain suspended food included swatting at the foodsack. The high percentage of packs and foodsacks damaged suggests the foodsack was usually torn in the process.

Bears also investigated objects around the camp. If packs were left closed the bears often tried to gain access to investigate further. Visitors often forgot to store such items as toothpaste with their food. Damage to the pack usually resulted. Our brochure counselled campers to leave the pockets and flaps on their packs open so a bear could investigate without hurting the pack. Similarly we encouraged people not to leave any odorous materials in their packs or tents. The low proportion of back-country incidents involving damage to tents suggests that most campers heeded the warning about tents.

The low percentage of damage to packs/foodsacks and tents reported in Wawona coincides with a low number of incidents reported in campgrounds in that management unit. The lower percentage of damage to packs/foodsacks in the other front-country subdistricts and greater percentage of damage to tents coincides with high incident reporting in campgrounds, but different food-storage procedures than in back-country areas. Front-country campers were instructed to store food in the trunk of their vehicle. In vehicles without trunks, they were instructed to cover the food with a blanket or other item not related to food, roll all windows up, and close doors tightly. In campgrounds where steel food storage lockers were provided, campers were asked to exclusively use lockers for food-storage.

The remaining objects were not typically associated with back-country incidents, so only Wawona and the other front-country subdistricts were considered. There was no difference ($p > 0.1$, $n = 332$) in the proportion of ice chests damaged; Wawona and other front-country units reported 8% and 12% ice chest damage, respectively.

There was a difference ($p < 0.001$, $n = 96$) between Wawona and the other front-country subdistricts in the proportion of incident reports identifying building damage. Wawona had more building damage ($p < 0.001$, $n = 60$) and the other front-country subdistricts less ($p < 0.001$, $n = 36$) than expected. Thirty-eight percent of the Wawona incidents included building damage compared to 1% of the other front-country incidents. Most of the Wawona building damage (57%) occurred during 1985 and was caused by one bear that was difficult to capture.

The proportion of motor vehicles reported damaged differed ($P < 0.001$, $n = 1,725$) between Wawona and the other front-country management units. Wawona reported fewer than expected ($P < 0.001$, $n = 43$), whereas other front-country subdistricts did not differ from the expected ($P > 0.1$, $n = 1,682$). Motor vehicle damage occurred in 27% of the Wawona incidents and 61% of the incidents in the other front-country subdistricts.

There was no difference ($P > 0.5$, $n = 67$) in the proportion of incidents involving towed units reported for either of the front-country management units. Only 2% of the reported incidents from both Wawona and the other front-country subdistricts were to towed units.

Regression analyses indicated neither positive nor negative trends over the 12-year period in number of Wawona incidents reporting damage to food/other, ($b = 1.52$, $P = 0.1320$) buildings, ($b = 1.14$, $P = 0.2213$), or motor vehicles ($b = 0.39$, $P = 0.2806$) . These results suggest that the information/education program, in the absence of an intensive capture and translocation effort, bear-proof refuse storage facilities, and law enforcement has been ineffective at reducing damage incidents. It appears that permitting bears access to human refuse, adjacent to developments, provides enough conditioning to promote a relatively stable number of bear incidents, with occasional marked increases.

In contrast, there was a significant downward trend in other front-country subdistricts in the number of incidents that reported damage to packs/foodsacks ($b = -3.14$, $P = 0.0091$), motor vehicles ($b = -39.19$, $P = 0.0059$), ice chests ($b = -4.24$, $P = 0.0017$), and towed units ($b = -1.62$, $P = 0.0082$). No decrease was observed in damage to food/other ($b = 3.22$, $P = 0.1934$), tents ($b = -2.52$, $P = 0.061$), or buildings ($b = -0.48$, $P = 0.1806$). Correspondingly, there was a decrease ($b = -5701.86$, $P = 0.0116$) in the total cost of property damaged in the front-country through the reporting period. Interestingly, there had been no decrease ($b = -1.83$, $P = 0.4534$) in the average cost per incident.

The active management program operative in the other front-country subdistricts, and greater ability to influence visitor behaviour, was reflected in greater program success. The large negative slopes for the number of bear incidents occurring in parking lots, campgrounds, and to motor vehicles demonstrates where the problem was the worst and the program most successful. It is also important to note that these subdistricts represented the greatest dollar value of property damaged among the 3 management areas considered, and offered the greatest variety of management options for dealing with the problem.

Food rewards • Whether or not food was present was recorded for each object damaged. There was a difference among management units considered ($P = 0.0000$, $n = 6,489$). Food was present in 97% ($n = 3,276$) of the back-country, 81% ($n = 166$) of the Wawona, and 90% ($n = 3,047$) of the other front-country damage incidents. No trend in the proportion of objects damaged with food present was apparent for any of the management units.

There was a difference ($P = 0.0000$, $n = 5,539$) among management units in whether or not a bear received a food reward from an incident. Food was obtained in 95% ($n = 2,782$) of the back-country incidents, 59% ($n = 160$) of the Wawona incidents and 72% ($n = 2,597$) of the incidents in the other front-country subdistricts.

No trend in the proportion of food rewards had occurred through the 12 years of the program for any of the management units ($b = 0.15$, $P = 0.3993$ for back-country; $b = -2.32$, $P = 0.2158$ for Wawona; $b = 1.00$, $P = 0.0646$ for other front-country subdistricts, $n = 12$). This implies that bears attempting to gain access to human property in 1986 experienced the same success rate at obtaining food as bears did at the beginning of the program. The reduction in front-country incidents suggests that fewer attempts were made.

Reasons for incidents • Reasons for bear incidents were different among the 3 management units considered ($P = 0.0000$, $n = 5,104$).

In the back-country, 72% of 2,445 incidents were due to victim error and 21% to conditioned bear behaviour. The proportion of back-country victim errors showed no increasing or decreasing trend ($b = -1.18$, $P = 0.0863$) with time. There was an increase ($b = 1.4$, $P = 0.0331$) in the proportion of conditioned bear responses in the back-country.

The high percentage of victim errors in the back-country may be due to the complicated food storage procedures required there, and visitors' lack of motivation to follow the directions in the brochure. The increasing proportion of conditioned bear responses suggested the importance of previous experiences in motivating the animals in their attempts to obtain food. In recent years we have noticed an increase in sophisticated behaviours to obtain food. For example bears have chewed through branches as large as 15 cm in diameter to obtain food, and have even jumped out of trees to grab properly stored food. Shaking branches or cables holding suspended food often caused unequally weighted, counterbalanced foodsacks to shift position, bringing one sack within reach from the ground.

In Wawona, 36% of 158 incidents were classified as visitor error and 29% as conditioned bear behaviour. Thirty-five percent were accidental encounters or some other reason. The proportion of incidents due to victim error and conditioned bear response showed no significant increasing or decreasing trends (b = -0.09, $\hat{p}$ = 0.9696 and b = -1.61, $\hat{p}$ = 0.4396, respectively).

The other front-country subdistricts reported 59% of 2,501 incidents were the result of victim error, and 38% were due to conditioned bear behaviour. The proportion of incidents due to victim error in the other front-country subdistricts increased (b = 2.0, $\hat{p}$ = 0.0186) and the proportion of conditioned bear responses decreased (b = -1.9, $\hat{p}$ = 0.0262) during the past 12 years. One might expect that as food availability is eliminated, highly conditioned bears would increase efforts to obtain foods, and less-conditioned bears would quit trying and return to natural foods. In the front-country subdistricts, the intensive capture/translocation program and destruction of animals that caused extensive property damage may have removed the individuals that increased their conditioned behaviour. Those animals have not been removed from back-country situations.

Personal Injuries

Regression analysis indicated a downward trend over time in the number of personal injuries (b = -0.91, $\hat{p}$ = 0.0382) for the park as a whole (Table 3). Of the 58 personal injuries reported during the 12-year period, 53% required no medical treatment. Thirty-four percent of the victims required only first aid, and 12% required medical attention. None of the victims required hospitalization and none of the injuries resulted in human death. We felt all of the injuries were accidental or defensive responses by bears to human behaviour and not the result of predatory or offensive behaviours.

CONCLUSIONS

Interpretive messages must be motivating to accomplish a change in visitor behaviour throughout the park. We have demonstrated that simply passing along information is insufficient. Interpretive programs, such as campfire talks and slide shows, may be effective at encouraging visitors to comply with recommendations, but must be done by experienced, dynamic professionals. The 16 mm movie "Forever Wild" is likely the most effective technique used in the park.

Brochures must be motivating and widely distributed to reach all potential victims. We encourage use of public relations professionals in developing printed material to ensure the message is effective.

Table 3. Number of reported personal injuries inflicted by black bears, in each management unit, Yosemite National Park, California, 1975-1986.

Year	Back-country	Wawona	Front-country[a]	Total
1975	3	2	12	17
1976	10	0	2	12
1977	3	0	2	5
1978	1	0	0	1
1979	1	0	2	3
1980	1	0	0	1
1981	1	0	0	1
1982	5	0	6	11
1983	3	0	0	3
1984	1	0	0	1
1985	0	1	1	2
1986	1	0	0	1
TOTAL	30	3	25	58

[a] Front-country subtotal includes Yosemite Valley, Big Oak Flat, Tuolumne Meadows and Badger Pass subdistricts.

Yosemite's back-country did not experience success in reducing property damage incidents. Progress in the back-country will depend on a commitment to providing more motivating interpretive experiences for visitors prior to their trip and improved opportunities for food storage. Mandatory viewing of the movie "Forever Wild" is recommended as well as widespread use of portable bear-proof food containers for backpackers. The increased conditioning of bears documented in our back-country areas indicates the situation has worsened since the program began. A more aggressive program of animal removals, or improved methods of bear deterrents for use by visitors, should be considered.

Similarly, Wawona did not experience a reduction in bear incidents. A planned system for the removal of human-provided foods must be implemented, followed by a more aggressive program for the control of problem bears. Installation of food storage lockers in the Wawona campground has been completed to reduce the opportunity for bear incidents there as food becomes less available elsewhere. Bear-proof refuse containers should next be placed at private inholdings. Again, coordinated interpretive efforts must convince potential victims of the importance and necessity of the program.

They must be directed primarily at local residents and secondarily at campers and visitors using rental units who park their vehicles in lots. The experiment of not translocating bears from Wawona may have been successful in stabilizing the population. Patterns of bear incidents in Wawona were consistent through the years of the program, since translocations ceased. Incidents were most numerous near residences where refuse was available. The level of conditioning of bears, encouraged by that situation, may have contributed to the periodic marked increases in the number of residential buildings damaged.

Significant progress in protecting visitors and their property was made in the front-country subdistricts, not including Wawona, during the first few years of the program. However, the lack of a significant reduction in property damage in those subdistricts during the past 10 years suggests the need for improved efforts to make campers' foods less available. The installation of food storage lockers in front-country campsites may satisfy that need. Interpretive programs should be directed primarily to campers and secondarily to visitors who park motor vehicles in lots or stay in tent cabins.

The program was also successful at reducing the number of personal injuries in all management units. The active capture/tagging program throughout the park allowed the identification and removal of extremely bold animals. This element of the program must be continued to ensure a reversal of current trends in personal injuries does not occur.

The above recommendations assume a moderate law enforcement approach, as used in Yosemite. An alternative motivating factor for visitors and residents would be a more aggressive law enforcement campaign, with mandatory citations and fines for failure to comply with food storage regulations. Such efforts were more successful in removing the availability of human foods in Yellowstone National Park (Meagher and Phillips 1983). They would be more cost-effective by reducing the need for expensive food storage facilities and labour-intensive interpretive programs and movies.

LITERATURE CITED

BARBOUR, M. G., and J. MAJOR, eds. 1977. Terrestrial vegetation of California. John Wiley and Sons, New York, NY 1002 pp.

GRABER, D. M. 1982. Ecology and management of black bears in Yosemite National Park. CPSU Tech. Rep. No. 5. Univ. California, Davis. 206 pp.

_____, and M. WHITE. 1983. Black bear food habits in Yosemite National Park. Int. Conf. Bear Res. and Manage. 5:1-11.

GRINNELL, J., and T. I. STORER. 1924. Animal life in the Yosemite. Univ. California Press, Berkeley. 752 pp.

HARMS, D. R. 1977. Black bear management in Yosemite National Park. Proc. Ann. Conf. West. Assoc. State Game and Fish Comm. 57:159-181.

HASTINGS, B. C., B. K. GILBERT, and D. L. TURNER. 1981. Black bear behavior and human-bear relationships in Yosemite National Park. CPSU Tech. Rep. No. 2. Univ. California, Davis. 42 pp.

KEAY, J. A., and J. W. VAN WAGTENDONK. 1983. Effects of Yosemite backcountry use levels on incidents with black bears. Int. Conf. Bear Res. and Manage. 5:307-311.

KEMP, G. A. 1976. The dynamics and regulation of black bear, *Ursus americanus*, populations in northern Alberta. Int. Conf. Bear Res. and Manage. 3:191-197.

MEAGHER, M., and J. R. PHILLIPS. 1983. Restoration of natural populations of grizzly bears in Yellowstone National Park. Int. Conf. Bear Res. and Manage. 5:152-158.

NORUSIS, M. J. 1984. SPSS/PC for the IBM PC/XT. SPSS Inc. Chicago, IL. 617 pp.

STOKES, A. W. 1970. An ethologist's views on managing grizzly bears. BioScience 20:1154-1157.

U.S. DEPT. OF THE INTERIOR. 1982. Human/Bear Management Plan. USDI, National Park Service, Yosemite National Park, California. 21 pp.

VAN WAGTENDONK, J. W. 1981. The effect of use limits on backcountry visitation trends in Yosemite National Park. Leisure Sci. 4:311-323.

BLACK BEAR - HUMAN INTERACTIONS IN SHENANDOAH NATIONAL PARK, VIRGINIA

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Abstract: From May 1982 to April 1985 we studied seasonal use of various areas of human disturbance by 24 adult female, 17 adult male, and 3 subadult male black bears (*Ursus americanus*) in central Shenandoah National Park, Virginia. A sample of 1,582 locations indicated that male bears were never located within 100 m of a front-country campground or picnic area; only 1 location was recorded within 100 m of a campground and picnic area for females. Male and female bears avoided more travelled primary roads ($P = < 0.01$) and light-duty roads ($P < 0.001$) year-round. However, both sexes used foot trails more often ($P < 0.05$) than expected during each season and annually. Bear incidents reported in Shenandoah National Park from 1970-1986 steadily declined, reaching their lowest level in the park's history in 1985-1986. Bear movements outside Shenandoah National Park, and resultant damage by bears to property surrounding agricultural lands and rural housing developments have become the greatest bear management problem facing park and state officials today. Education of park visitors about the proper response when encountering a bear, especially along back-country trails, is strongly recommended.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Shenandoah National Park was established in 1935 through the purchase of approximately 78,600 ha from private landowners. At that time, sightings of black bears were considered rare and the indigenous bear population may have numbered only a few individuals. By the late 1950's, an estimated 75 black bears inhabited the park (Haskell 1982). In the last 50 years, protection from hunting, maturation of hardwood forests (acorns, hickory nuts), and intensive farming near the park boundary (apples, peaches, corn, honey) have resulted in one of the densest black bear populations in North America, with 1 bear/10.96 - 1.49 km^2 (Carney 1985). Construction of Skyline Drive (major scenic route), lodges and concession facilities, campgrounds, trails, and picnic areas since the park's establishment have led to a concurrent increase in visitor use. By the mid-1960's, increased bear-human interactions in the park, along with complaints of crop damage by bears from farmers on adjacent farmland, prompted park personnel to establish a black bear management policy.

The primary objective of the current Shenandoah National Park Bear Management Plan involves the management of a viable bear population with minimum bear-human conflicts (Haskell 1982). This involves a 3-fold effort to (1) maintain visitor use of back-country and front-country through regulations and management actions that will cause minimal disruption to the natural behavioural patterns of the bear population; (2) establish and maintain an system to monitor the population dynamics of park bears; and (3) work closely with local universities, and state and federal resource management agencies, to develop needed research and cooperative bear management program elements.

Bears and people in Shenandoah National Park are numerous and little is known about requirements of bears in the park. The study described in this paper was initiated to help develop a more effective management plan, that would further alleviate potential bear-human problems by determining seasonal movement patterns of black bears in relation to areas of human disturbance in the park. This work was part of a comprehensive study of black bear ecology and biology on the Shenandoah National Park forests.

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STUDY AREA

The study area was the 307-km^2 Central District of Shenandoah National Park in the Blue Ridge Mountains of northern Virginia and surrounding environs (Figure 1). The Central District of the park is characterized by rugged terrain, steep slopes, and narrow valley bottoms. Elevation ranges from 274 m to 1,234 m. The district is 3 - 21 km wide, 40 km long, and is oriented in a southwest-northeast direction.

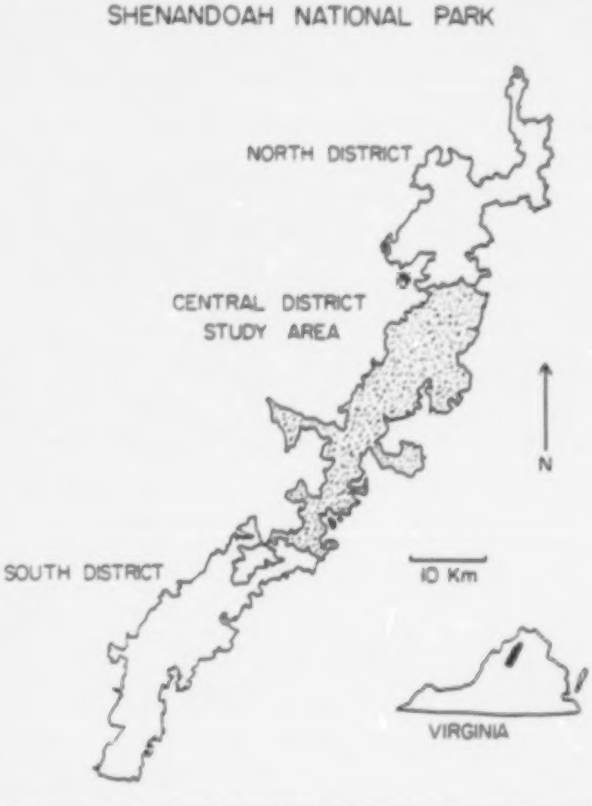

Figure 1. Study area in Shenandoah National Park, Virginia.

Nearly 95% of Shenandoah National Park (777 km^2) is forested, with approximately 100 tree species and more than 1,000 species of shrubs, forbs, and grasses (Mazzeo 1979). The study area is dominated by upland hardwood forests that include northern red oak (*Quercus rubra*) and chestnut oak (*Q. prinus*) as the predominant tree species, mixed with white oak (*Q. alba*) and hickory (*Carya* spp.) along ridges and slopes at all elevations. The remaining 5% of the study area is covered by utility corridors, scenic overlooks, meadows, burns, talus slopes, roads, and large rock formations.

Precipitation averages 15 - 20% more, and temperatures are 5.5°C cooler, at higher elevations in the park than in surrounding lowlands (Heatwole 1978). Temperatures in the upper elevations range from a mean of -2.3°C in January to 19.2°C in July. Average annual precipitation at the higher elevations is 125 cm of rain plus 122 cm of snow.

METHODS

Bears were captured in Aldrich foot snares and culvert traps from 1982 through summer 1984, and immobilized with intramuscular injections of ketamine hydrochloride and xylazine hydrochloride in a 2:1 mixture (dosage rate 6-11 mg/kg of body weight). Individual black bears were fitted with motion-sensitive radio-transmitter collars (Telonics Inc., Mesa, AZ 85203).[1]

Radio-marked bears were monitored during all seasons through April 1985 and located during daylight hours between 0600 and 2100. We attempted to locate each bear every 2 - 3 days from the ground and once a week from the air. Ground locations were determined using triangulation of radio fixes with directional hand-held H antennas. Aerial locations were made from fixed-wing aircraft (Cessna 150, 172) with directional H antennas mounted under each wing. All locations were plotted on U.S. Geological Survey topographic maps (scale 1:24,000) using the Universal Transverse Mercator (UTM) grid system. Ground locations were triangulated by program TELEM (Koeln 1980).

Only aerial locations and fixes ≤100 m from the investigator were used for analyses. We tested the accuracy of aerial locations by (1) locating bears at den sites; and (2) periodically locating reference transmitters placed in known locations within the study area. Greater distance triangulations (>100 m but usually between 0.50 and 2 km from investigator (were not used for analyses because of inaccuracies associated with bearing error (±5-7°) over steep and rugged terrain, and our inability to verify the presence of bears in the triangulated area (Lee et al. 1985).

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[1] Reference to this or any other product or trade name does not imply endorsement by the U.S. Government.

Locations of bears were grouped by season and sex of the bear. Seasons were based on changes in plant phenology and weather patterns: spring (20 Mar - 15 Jun); summer (16 Jun - 31 Aug); early fall (1 Sep - 15 Oct); and late fall (16 Oct - 20 Dec).

We used Chi-square tests to determine if there was a difference ($P < 0.05$) between seasonal locations of bears and random points over the entire study area that fell within 100 m of various areas of human disturbances (Table 1). Wilcoxon rank sum tests were used for all other analyses (SAS Institute 1982). Two-sided significance levels are reported.

A review of the Shenandoah National Park bear management program, bear incident rate, and patterns of visitor use is included to identify past and present problems concerning bear-human interactions in and around the park.

Table 1. Descriptions of human disturbance areas electronically digitized and incorporated into a geographic data base for Shenandoah National Park, Virginia.

Feature	Description
Campgrounds	Four campgrounds open to recreational vehicle use covered 57 ha inside the park. Big meadows and Lewis Mountain campgrounds occurred in the Central District.
Fire Roads	Dirt roads located in the park and on surrounding state forests primarily used for fire control and back-country patrol (law enforcement). Fire roads totalled 726 km.
Foot Trails	Hikers used 897 km of trails in the park and on surrounding state forests.
Light Duty Roads	Gravel roads which totalled 643 km within and immediately surrounding the park.
Picnic Areas	Seven picnic areas in the park covered 45 ha. The Pinnacles and South River picnic areas occurred in the Central District.
Primary Roads	Paved roads which included primary and secondary highways located within and immediately surrounding the park. Primary roads were 523 km in length. The longest section of primary road was Skyline Drive which bisected the entire park for 169 km.

RESULTS AND DISCUSSION

Present Bear Management Program

Black bears in Shenandoah National Park are currently viewed by park managers as a dynamic resource to be managed as a population rather than as individuals. The Shenandoah National Park bear management program addresses management concerns that deal with front-country and back-country areas, as each exhibits different types of bear problems. Management efforts in the front-country are directed at controlling the presence of bears in easily accessible areas developed for visitor use. Conversely, management efforts in the back-country concentrate on altering activities of visitors rather than on taking action against offending bears.

Management actions usually follow a stepwise plan that proceeds from least to most severe and is appropriate for each situation and area. The actions are (1) control and removal of unnatural food sources; (2) visitor warnings; (3) restrictions on visitor use; (4) trapping and removal of problem bear(s); and (5) destruction of problem bear(s). The success of these actions rests solely on their proper implementation by park personnel. The park's bear incident reporting system, which catalogues daily all incidents involving aggressive or conditioned behaviour, property damage, personal injury, or reports of bears foraging in developed areas, is instrumental in the overall success of the program.

History of Bear-Human Conflicts

A total of 1,461 bear incidents and 19 personal injuries have been recorded since the park began keeping reliable records in 1970 (Table 2). No person has ever been killed by a black bear in Shenandoah National Park and only 5 people were injured between 1976 and 1986.

Front-country • In general, fluctuations in numbers of bear incidents in Shenandoah National Park can be attributed to various management actions taken in front-country areas, rather than to yearly changes in visitation rates (Table 2). Immediately following the closure of garbage dumps in 1973 and the bear-proofing of all garbage cans in 1974, bear incidents more than doubled from 99 in 1974 to 234 and 257 during 1975 and 1976, respectively. That increase was confined mainly to front-country areas despite a record level of back-country camping from 1973 to 1977 (Table 2). During 1975 to 1981, 41 problem bears were removed, primarily from front-country areas, and relocated to remote areas outside the park. During that period, property damage

Table 2. Visitor use and black bear incidents in Shenandoah National Park, Virginia, 1970-1986.

Year	Total Visitation	Bear Incidents per 10,000 Visitors	Overnight Stays in Back-country	Total Number of Bear Incidents	Personal Injuries
1970	--	--	49,264	17	2
1971	2,406,469	0.299	57,307	72	6
1972	2,304,096	0.464	75,917	107	4
1973[a]	2,574,271	0.377	120,536	97	1
1974[b]	2,215,268	0.447	96,087	99	0
1975	2,686,481	0.871	112,306	234	1
1976	2,714,469	0.947	99,238	257	1
1977	3,055,000	0.380	91,317	116	1
1978[c]	2,091,547	0.760	75,233	159	0
1979	1,625,722	0.332	62,831	54 (42)[d]	0
1980	1,769,724	0.379	66,728	67 (45)	0
1981	1,894,280	0.227	61,613	43 (31)	3
1982	1,848,058	0.346	54,720	64 (50)	0
1983	1,838,862	0.152	52,522	28 (13)	0
1984	1,944,153	0.134	45,166	26 (11)	0
1985	1,960,966	0.041	43,046	8 (3)	0
1986	1,866,684	0.070	38,134	13 (4)	0

[a] All 3 garbage dumps in park closed by 1973.

[b] All garbage cans in park bear-proofed by 1974.

[c] Estimates for total park visitation changed from 3.5 persons per car to 2.8 persons per car.

[d] Value in parentheses indicates number of incidents resulting in damage to personal property.

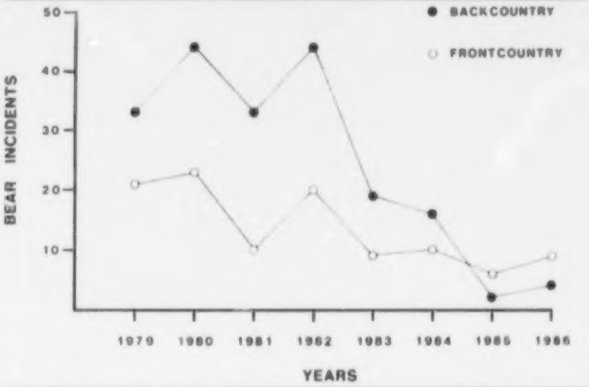

Figure 2. Number of black bear incidents in front-country and back-country areas of Shenandoah National Park, Virginia, 1979-1986.

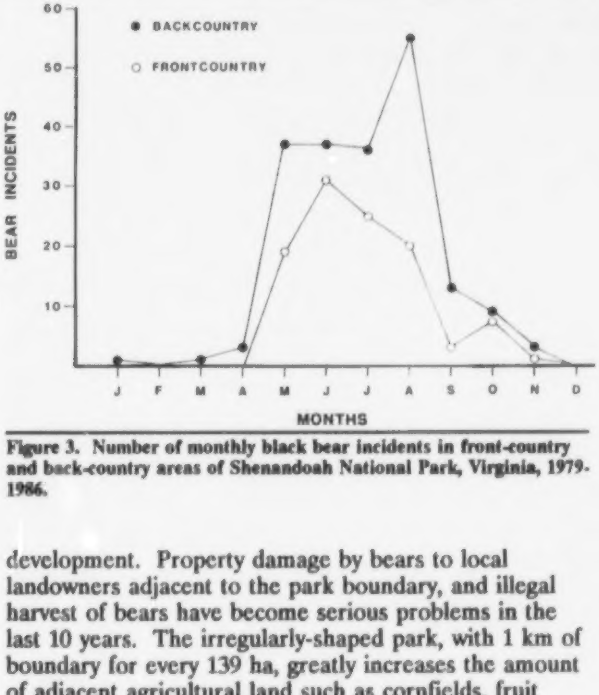

Figure 3. Number of monthly black bear incidents in front-country and back-country areas of Shenandoah National Park, Virginia, 1979-1986.

was reduced from $14,672 to $3,189 and the overall number of bear incidents dropped from 234 to 43. From 1982 to 1986, only 6 problem bears were relocated to remote sites inside and outside the park. During the last 8 years (1979-1986), front-country bear incidents declined from 21 to 8 and occurred largely from May through August (Figures 2 and 3).

Back-country • After the removal of unnatural food sources and the removal of problem bears from front-country areas during the 1970's, the park still contained a large bear population. From 1979 to 1982, bear incidents shifted from front-country to back-country areas, where close encounters between bears and people increased substantially (Figure 2). More recently, back-country bear incidents declined from 44 in 1982 to 5 in 1986. The majority of back-country encounters between bears and people over the last 8 years (1979-1986) occurred during the heavy visitation period from May through August (Figure 3).

Park boundary and adjacent lands • The park is increasingly becoming an island surrounded by human development. Property damage by bears to local landowners adjacent to the park boundary, and illegal harvest of bears have become serious problems in the last 10 years. The irregularly-shaped park, with 1 km of boundary for every 139 ha, greatly increases the amount of adjacent agricultural land such as cornfields, fruit orchards, and beehives that bears visit when searching for food. Telemetry data indicated that males and females were located 32% and 15% of the time, respectively, outside the park (Garner 1986).

Movement of wide-ranging bears out of the long and narrow park and into surrounding agricultural and rural housing developments has become the greatest bear management problem for Shenandoah National Park and state officials. Approximately 25-40 nuisance bears are currently trapped and relocated each year by the Virginia Commission of Game and Inland Fisheries on private lands surrounding Shenandoah National park because of damage to agricultural crops, beehive operations, and livestock.

Reasons for Recent Decline in Bear Incidents

Bear incidents during the last 2 years (1985-1986) in Shenandoah National Park are at their lowest level since park officials started keeping records (Table 2). The reduced number of bear-human interactions occurred despite a stable black bear population (Carney 1985). There are 5 possible reasons why bear incidents have declined.

1. There has been a substantial drop in backcountry camping. Overnight stays in the backcountry have declined from 66,728 in 1980 to 38,134 in 1986 (Table 2).
2. Bears have increased use of areas outside or along the park boundary.
3. Bears may now be completely habituated to natural foods in the park.
4. The number of legally harvested bears has increased 2-fold from 1975-1980 ($\bar{x}=102$, range 88-125), compared to 1981-1986 ($\bar{x}=208$, range 167-266), in the 8 counties surrounding Shenandoah National Park. The large increase in numbers of bears killed immediately adjacent to the park since 1981 may have reduced overall numbers of bears in the park (number of illegally harvested bears not known), or reduced the number of aggressive or conditioned individuals.
5. Aversive conditioning on a portion of the bear population may have occurred through trapping and chemically immobilizing 114 different bears (excluding den work) from 1982-1983. None of the bears marked after handling was ever later reported as a nuisance animal within the park. That included 1 adult female and 1 adult male (both radio-collared) known to be problem bears before we captured and returned them to the park in 1982 and 1984, respectively. A significant decrease also occurred in numbers of bear incidents reported from the Central District between the periods 1979-1982 ($\bar{x}=27.75$) and 1983-1986 ($\bar{x}=4.0$),($P=0.03$). Combined bear incidents for the same 2 periods in the untrapped areas of the North and South Districts (1979-1982, $\bar{x}=29.25$; 1983-1986, $\bar{x}=14.75$) were not different ($P=0.31$), (Figure 4).

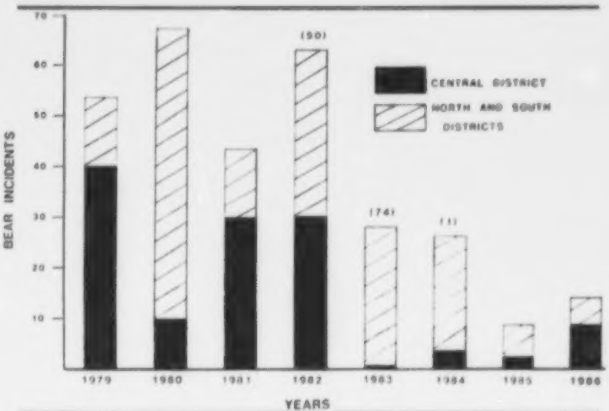

Figure 4. Frequency of black bear incidents for the 3 districts of Shenandoah National Park, Virginia, 1979-1986. Numbers in parentheses indicate different bears trapped and chemically immobilized in Central District during specified years (excluding den work).

The possible deterrent effect of stray hunting dogs, illegal harvest, legal hunting, and park visitors' dogs on park bears is unknown.

Current Use by Bears of Areas of Human Disturbance

A total of 47 collared bears, including 25 adult females, 17 adult males, and 5 subadult males <3.5 years old, were monitored during the study. A sample of 1,582 daytime locations was used for analyses. Individual bears were radio-tracked for periods ranging from 2 weeks to 34 months. The number of bears of each sex radio-tracked each season, excluding winter, ranged from 12 to 23.

Bears were located (aerial and close ground triangulation) every 7-8 days on average. We believe these observations were independent and unbiased based on the average time interval between successive locations (Dunn and Gipson 1977). During aerial tracking bears were frequently seen in spring (10.2% visuals) and late fall (26.3% visuals) when deciduous cover was limited. Accuracy tests indicated that aerial locations were within 100 m 95% of the time. Close ground triangulations were considered highly accurate due to the close proximity of the investigator to the bear.

Table 3. Percent of male black bears and random points that occurred within 100 m of human disturbance areas within the Central District of Shenandoah National Park, Virginia, 1982-1985.

		Location of Bears									
	Random Points (N = 1751)	Spring (N = 119)		Summer (N = 179)		Early Fall (N = 58)		Late Fall (N = 103)		Total Season (N = 459)	
Feature	%	%	P	%	P	%	P	%	P	%	P
Campgrounds	--	0.00		0.00		0.00		0.00		0.00	
Fire Roads	12.05	5.04	<0.05	7.82		3.45	<0.05	2.91	<0.01	5.45	<0.001
Foot Trails	12.85	21.85	<0.01	18.44	<0.05	34.48	<0.001	21.36	<0.05	22.00	<0.001
Light Duty Roads	10.97	1.68	<0.01	8.94		1.72	<0.05	2.91	<0.01	4.79	<0.001
Picnic Areas	--	0.00		0.00		0.00		0.00		0.00	
Primary Roads	6.97	1.68	<0.05	3.91		5.17		2.91		3.27	<0.01

Table 4. Percent of female black bears and random points that occurred within 100 m of human disturbance areas within the Central District of Shenandoah National Park, Virginia, 1982-1985.

		Location of Bears									
	Random Points (N = 1751)	Spring (N = 234)		Summer (N = 442)		Early Fall (N = 227)		Late Fall (N = 220)		Total Season (N = 1123)	
Feature	%	%	P	%	P	%	P	%	P	%	P
Campgrounds	--	0.00		0.00		0.00		0.45		0.09	
Fire Roads	12.05	14.10		18.10	<0.001	18.94	<0.01	12.27		16.30	<0.01
Foot Trails	12.85	26.07	<0.001	25.11	<0.001	25.11	<0.001	23.64	<0.001	25.02	<0.001
Light Duty Roads	10.97	0.85	<0.001	5.88	<0.01	1.76	<0.001	0.45	<0.001	2.94	<0.001
Picnic Areas	--	0.00		0.23		0.00		0.00		0.09	
Primary Roads	6.97	2.14	<0.01	2.26	<0.001	3.52	<0.05	5.00		3.03	<0.001

We considered bears located within 100 m of any specific area of human disturbance close enough to be influenced by it. Therefore, bears either preferred or avoided those areas based on the proportion of locations ≤100 m or >100 m from the areas when compared with proportions of random locations (Tables 3 and 4). It is important to note that preference for or avoidance of areas of human disturbance may be due to other factors, such as characteristics of the surrounding habitat. Daytime locations were used as bears were largely diurnal during the summer when park visitation peaked (Garner 1986).

Roads • Males avoided fire roads ($P < 0.001$), light-duty roads ($P < 0.001$), and primary roads ($P < 0.01$) year-round. Females preferred fire roads during summer ($P < 0.001$) and early fall ($P < 0.01$) and avoided more heavily travelled roads, such as light-duty roads ($P < 0.001$) and primary roads ($P < 0.001$), year-round (Tables 3 and 4). Avoidance by bears of more heavily travelled roads in and around Shenandoah National Park was likely due to human activity. Distances from bears to 5 different classes of roads in West Virginia indicated that males and females avoided more heavily travelled roads (Brown 1980). In the southern Appalachians, Quigley (1982) and Villarrubia (1982) also reported that bears avoided roads, while Carr (1983) speculated that bears regularly crossed roads and trails, and used areas around them, due to the spatial arrangement of bear home ranges in relation to such features.

Trails • Both male and female bears in Shenandoah National Park preferred foot trails and adjacent areas each season and annually ($P < 0.05$) (Tables 3 and 4). Most of the foot trails in the park originated from animal trails and old roads or foot trails used by mountain residents prior to the establishment of the park. Most foot trails in the park follow water courses or ridgetops. Bears use these trails extensively throughout much of the park as unobstructed pathways over steep and rocky terrain.

Campgrounds and picnic areas • Males were never located within 100 m of a campground or picnic area (Table 3). Only 1 location for females was recorded within 100 m of a campground or picnic area during the study (Table 4). Bears have little opportunity to consume human foods in Shenandoah National Park due to strict enforcement of rules concerning proper storage and handling of food in all areas of the park. Park visitors realized that their carelessness caused most bear problems in developed areas of the park (Baptiste et al. 1979). Human-related food items were only a trace item (<1% volume) in the annual diets of park bears during the study (Garner 1986).

IMPLICATIONS FOR VISITOR USE

All visitors that drive through Shenandoah National Park are given a brochure that provides general information about the habits of black bears in the park, along with statements concerning bear problems and appropriate warnings. However, no recommended responses to confrontations with bears, whatever the circumstances, are included. Baptiste et al. (1979) found that most visitors to Shenandoah National Park are unsure of how to respond when a bear is encountered. One area where park managers can focus their efforts to decrease bear-human conflicts involves further education for people using back-country trails. As male and female black bears prefer park trails and adjacent areas during all seasons, education of the public concerning responses to encounters with bears along trails is strongly recommended. Such education is essential from April through October when back-country use of trails by park visitors is heaviest.

Back-Country Camping

The park has a dispersed back-country camping system with no specifically designated campsites. Back-country camping is only prohibited within view of any road or trail or within 0.8 km of any developed area and 7.6 m from a stream. Maximum group size is 10 persons and camping in 1 location is limited to 2 consecutive nights. Wood fires and glass are prohibited and all litter must be carried out. Park personnel are only required to issue permits to back-country campers, inform them of current back-country status, and explain proper food storage and camp maintenance to avoid problems with bears. More education of back-country campers is recommended during the permit process to ensure hikers avoid personal injury if a close encounter with a bear should occur.

Use of Day Trails

In addition to back-country campers, approximately 250,000 day-use hikers use the park's back-country trail system each year. Park officials estimate that approximately 50,000 of these day hikers enter Shenandoah National Park at boundary trailheads. Currently, no system exists to educate day hikers about proper response to close encounters with bears along trails to avoid personal injury. We strongly recommend that such information be made available at all trailheads to educate back-country day hikers as well as campers about encounters with bears. Information dispensers at trailheads are needed as 20% of day hikers and many back-country campers access trails along the park boundary without passing official Shenandoah National Park entrance stations.

LITERATURE CITED

BAPTISE, M. E., J. B. WHELAN, and R. B. FRARY. 1979. Visitor perception of black bear problems at Shenandoah National Park. Wildl. Soc. Bull. 7:25-29.

BROWN, W.S. 1980. Black bear movements and activities in Pocahontas and Randolph counties, West Virginia. M.S. Thesis. West Virginian University, Morgantown. 90 pp.

CARNEY, D. W. 1985. Population dynamics and denning ecology of black bears in Shenandoah National Park, Virginia. M.S. Thesis. Virginia Polytechnic Inst. and State Univ., Blacksburg. 84 pp.

CARR, P. C. 1983. Habitat utilization and seasonal movements of black bears in the Great Smoky Mountains National Park. M.S. Thesis. Univ. Tennessee, Knoxville. 95 pp.

DUNN, J. E., and P. S. GIPSON. 1977. Analyses of radio telemetry data in home range studies. Biometrics 33:85-101.

GARNER, N. P. 1986. Seasonal movements, habitat selection, and food habits of black bears in Shenandoah National Park, Virginia. M.S. Thesis. Virginia Polytechnic Inst. and State Univ., Blacksburg. 104 pp.

HASKELL, D. A. 1982. Shenandoah National Park bear management plan. Natl. Park Serv., Shenandoah National Park Headquarters, Luray. 13 pp. (Mimeograph).

HEATWOLE, H. 1978. Guide to Skyline Drive. GOOD Printers, Harrisonburg. 226 pp.

KOELN, G. T. 1980. A computer technique for analyzing radio-telemetry data. Proc. Natl. Wild Turkey Symp. 4:262-271.

LEE, J. E., G. C. WHITE, R. A. GARROTT, R. M. BARTMANN, and A. W. ALLDREDGE. 1985. Assessing accuracy of a radiotelemetry system for estimating animal locations. J. Wildl. Manage. 49:658-663.

MAZZEO, P. M. 1979. Trees of Shenandoah National Park. Shenandoah Natural History Association, Inc., Luray. 76 pp.

QUIGLEY, H. B. 1982. Activity patterns, movement ecology, and habitat utilization of black bears in the Great Smoky Mountains National Park, Tennessee. M.S. Thesis. Univ. Tennessee, Knoxville. 140 pp.

SAS INSTITUTE INC. 1982. SAS user's guide: Basics, 1982 Edition. SAS Institute Inc., Cary, N.C. 923 pp.

VILLARRUBIA, C. R. 1982. Movement ecology and habitat utilization of black bears in Cherokee National Forest, Tennessee. M.S. Thesis. Univ. Tennessee, Knoxville. 159 pp.

A REVIEW OF PROBLEM BLACK BEAR MANAGEMENT IN WISCONSIN

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Abstract: The Wisconsin Department of Natural Resources (WDNR) paid $229,453 on 2,784 black bear (*Ursus americanus*) damage claims from 1939 to 1979, through its Wildlife Damage Compensation Program. Public dissatisfaction, however, existed with the program throughout its duration. Concern centered around the high costs of administration, the lack of funding, the relatively few landowners assisted, and the lack of emphasis on abatement. In 1983, the Wisconsin Wildlife Damage Abatement and Claims Program was established. It requires that damage abatement practices receive priority over damage claims and provides 50:50 cost-sharing for abatement projects. Damage claims are paid if suitable funds are available. Funds for the program are generated by a $1 surcharge on all hunting licences. The WDNR started live-trapping and relocating bears in 1950. They increased live-trapping efforts from 1980-1983, a period when there was no bear damage program, and relocated 288 problem bears. Before 1957, landowners were allowed to shoot bears causing damage at any time. Subsequently, a WDNR-issued permit was required prior to shooting and 1,041 bears were destroyed under permit between 1957 and 1980. The establishment of a September bear hunting season in 1963 decreased the average number of bears destroyed per year under shooting permits from 110 to 19 and increased the harvest of bears that were causing damage. Three black bear management zones were established in 1986 to provide control of hunter distribution and bear harvest. Increased harvests will be directed at areas with excessive bear damage. Public information and research are important components of the black bear management program in Wisconsin.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Wisconsin has experienced a long history of public policy and debate regarding black bear management. Human settlement, land use, and attitudes have greatly affected the abundance, distribution, and status of black bears through the years. Black bears were once common throughout Wisconsin; however, their population is now limited to about 5,000 animals in the northern third of the state (Kohn 1982). There is a wide range of opinions regarding black bears in the state. To some people, black bears are of great aesthetic importance - a symbol of the American wilderness. To hunters, they are regarded as a challenging trophy animal. Still others perceive them as a threat to their families, farms, and other personal property. In response to these interests, the Wisconsin Department of Natural Resources (WDNR) developed bear management programs to improve harvest regulations, nuisance and damage control, research, and public information. In this paper we review the history of problem bear management in Wisconsin, and discuss aspects that have been effective or shown promise in reducing bear-people conflicts. Chronological sections of the paper (Past, Present, Future) are further subdivided by bear management subjects (i.e. Trapping, Shooting, Harvest Management, Damage Abatement, and Claims Programs).

We thank R. K. Anderson, B. E. Kohn, and F. P. Haberland for providing information and B. E. Kohn and R. L. Ruff for making helpful suggestions on early drafts of the manuscript. This paper is presented in memory of black bear researcher and friend, J. L. Massopust.

THE PAST (1848-1979)

Black bears were common throughout Wisconsin when it attained statehood in 1848 (Schorger 1949, Jackson 1961). By the early 1900's, however, black bear distribution was limited to the northern half of the state. Human settlement and timber harvest had eliminated most of the black bear habitat in the southern half (Figure 1). Continued timber harvest and subsequent fires in the north further reduced bear numbers to about 1,000 animals near the turn of the century.

Settlement within bear range during the mid-1900's continued. Bear hunting seasons were closed from 1920-1933 to protect the existing population (Scott 1947). By 1947, the bear population increased to 2,000-2,700, and bear damage complaints had risen substantially (Becker

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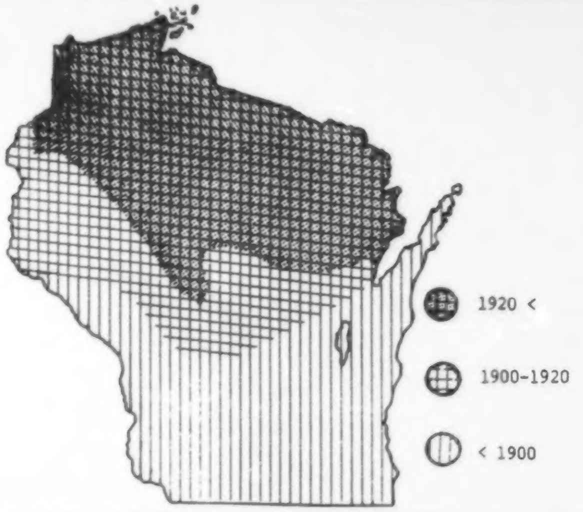

Figure 1. Distribution of black bears in Wisconsin.

1940, Scott 1947). Many of the early complaints were the result of activities of bears at open-pit garbage dumps (Knudsen 1957, Creed 1958). These problems were eliminated by 1970 through improved disposal techniques, the closure of many open-pit dumps, and public information programs by the WDNR to minimize the use of dumps as bear viewing areas. Other bear damage complaints involved substantial financial loss to apiaries, crops, livestock, and buildings.

Damage Compensation

In 1939, the Wisconsin legislature added black bears to a previously existing wildlife damage program that was administered by the WDNR. The Wildlife Damage Compensation Program was established in 1930 to pay claims for damage caused by white-tailed deer (*Odocoileus virginianus*) and waterfowl (*Anatinae* spp.). This action empowered the WDNR to pay property damage claims that were the result of black bear activity and to capture or destroy bears that were causing damage. The program was established primarily to appease landowners who were experiencing bear damage problems in the northern half of Wisconsin. From 1939-1979, the WDNR paid $229,453 on 2,784 bear damage claims. For most years, funding levels for claims were inadequate. Therefore, payments were prorated on available funds. From 1939-1956, most payments were for losses of sheep (Figure 2). The remaining funds were divided according to losses of cattle (17%), apiaries (17%), and crops such as corn, oats, wheat, apples, vegetables, and clover (16%). Sheep production declined dramatically from 1956 to 1979, while honey and crop production increased. Changes in northern Wisconsin agriculture from 1956-1979 resulted in changes in the distribution of damage payments to landowners with apiaries (38%), cattle (27%), sheep (6%) and crops (29%) (WDNR unpubl. data 1986).

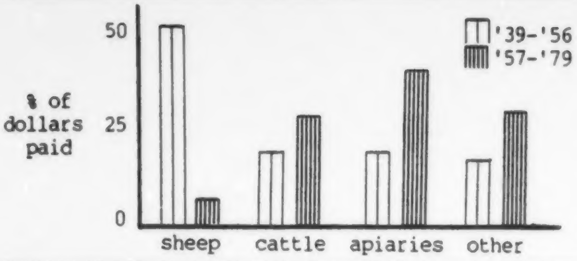

Figure 2. Distribution of claim payments for black bear damage in Wisconsin, 1939-1956 and 1957-1979.

Dissatisfaction with the Wildlife Damage Compensation Program existed throughout its duration. Landowners were disappointed with damage assessments, the lack of funds available for claim payments, and their inability to control damage. Legislators and WDNR personnel expressed concern over the high cost of administration, the relatively few landowners who were provided assistance, and the lack of emphasis on abatement. The Wisconsin legislature terminated the program in 1979.

Trapping

A bear trapping season was established in Wisconsin in 1945, but was rescinded in 1956. Accurate trapper harvests were not maintained. Problem bears were trapped with steel leg-hold traps, and subsequently killed, before 1950. After 1950, the WDNR live-trapped bears with barrel traps. Accurate records on the number of bears trapped were not maintained.

Shooting

No permits were required for landowners to kill bears that were causing damage before 1957. Thereafter a WDNR-issued permit was required for the removal of problem bears. This action provided the WDNR control over the number of problem bears killed and reduced the indiscriminate shooting of nuisance bears. Shooting permits were issued when trapping was impractical or bears presented a threat to human health and safety. From 1957-1979, 1,041 bears were destroyed under permit. The average number of bears destroyed per year under shooting permits dropped from 110 during

1957-1962 to 19 during 1963-1979. This was largely the result of both the establishment of a September bear hunting season in 1963 and the increased reluctance of WDNR personnel to issue shooting permits.

Harvest Management

Black bears were unprotected in Wisconsin before 1920. Bear hunting was not permitted in 1920-1933, 1935, 1941 and 1949 because of low numbers of bears. Gun and bow hunting seasons were established in 1934 and 1942, respectively. In 1963, the traditional November bear hunting season was changed to 16-23 day September season. The September season increased the harvest of bears that were likely causing damage in the fall. Before 1963, most bears were harvested in November by deer hunters who encountered and killed bears in winter dens. The new season precludes this questionable hunting technique; however, it does allow the use of dogs and bait. Since 1963, the average annual harvest has been 409 black bears.

Mandatory registration of harvested bears was initiated in 1956, and this greatly increased the reliability of bear population indices. Kohn (1982) summarized bear harvest registration data from 1956-1980 and compared harvest rates of ear-tagged bears during 2 periods, 1958-1962 and 1975-1979. He concluded that harvest rates had not changed significantly since 1963 and that, despite short-term fluctuations, the bear populations had remained stable from 1956 to 1980.

THE PRESENT (1980-1986)

The primary range of Wisconsin black bears is currently limited to the northern third of the state (Figure 1). A density of 1 bear/4 km^2 of forested land was estimated for a 1,119 km^2 representative study area in northern Wisconsin (Kohn 1982). The recent statewide population estimate has ranged from a high of 6,100 in 1981 to a low of 3,600 in 1984.

The WDNR field offices have played the major role in managing problem bears. Most complaints about nuisance bears involve garbage, bird feeders, the mere presence of bears around human dwellings, and other real or perceived problems not involving substantial financial loss. In 1986, 58% (384 of 661) of the complaints in northwestern Wisconsin were about nuisance bears. About 75% of these complaints were resolved by offering advice on proper sanitation and disposal of bear attractants.

Harvest Management

Interest in black bear hunting increased dramatically in Wisconsin during the 1980's. There was no limit on the number of permits issued by the WDNR each season, and hunter numbers peaked at 8,366 in 1982. The increased interest in black bear hunting resulted in annual harvests that exceeded 1,000 bears during each of 4 consecutive years from 1981-1984. The average age of harvested bears decreased over these years, and bear population models (Kohn 1985) indicated that numbers of bears had dropped below population goals and would continue to decline if harvests continued at that rate. The WDNR closed the bear hunting season in 1985. In 1986, the Wisconsin legislature granted the WDNR new authority to establish a 3-zone permit system for bear hunting (Figure 3). The management zones were established to provide control of hunter distribution and black bear harvest. Harvest management can now be used as a tool to reduce bear populations where damage problems are severe. In 1986, 851 hunters received bear harvest permits and harvested 503 bears. An additional 8,361 hunters purchased bear pursuit permits that allowed them to assist in the hunt. The current statewide bear population goal is 5,500, which should sustain an annual harvest of 1,000 bears.

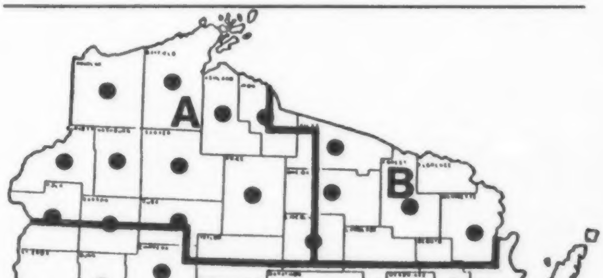

Figure 3. Wisconsin Department of Natural Resources black bear management zones (A, B, C) and counties enrolled in Wisconsin's Wildlife Damage Abatement and Claims Program (●).

The WDNR spends about $210,000 on bear management annually. Most is spent on law enforcement ($120,000) and bear complaints ($70,000), with the remainder divided among research, surveys, harvest registration, and habitat improvement (Anonymous 1982). Hunters have played an important role in funding bear management programs in Wisconsin. An average of 7,607 bear hunting licences were sold each year during 1980-1984 and 1986, which generated an average annual income to the WDNR of $96,095 (WDNR unpubl. data 1986).

Research is an integral part of Wisconsin's bear management program. WDNR researchers studied the population dynamics, status, and harvest management of black bears in Wisconsin (Kohn 1982). This work led to the development of a population model (Kohn 1985) that is used to determine bear population size and response to harvest management strategies. University of Wisconsin-Stevens Point (UW-SP) researchers are currently studying bear habitat use and population parameters that will be used to strengthen the population model.

Trapping

WDNR personnel continue to trap and translocate bears where they cause excessive property damage or are a safety concern or persistent nuisance. Live-trapping is done with Aldrich foot snares and barrel or culvert traps. Trapping and relocation efforts increased during the early 1980's because of the termination of the Wildlife Damage Compensation Program in 1979. During 1980-1985, 288 bears were trapped, ear-tagged, and relocated. Bear damage was widespread and severe in Wisconsin in 1986 because of a significant shortage of natural foods and a slight increase in the bear population. Approximately 300 bears were trapped and relocated in 1986. Researchers at the UW-SP have studied black bear home ranges, habitat use, and homing tendencies in response to relocation and pursuit by dogs (Massopust 1984, Massopust and Anderson 1984). Many questions remain unanswered regarding the efficacy of bear trapping and relocation.

Shooting

Shooting permits are still issued to landowners by the WDNR when public health and safety are a concern or where trapping is not feasible. Permits specify the location, dates, and number of bears that can be killed. Fewer permits were issued after 1980 because of the increased interest in bear hunting in Wisconsin. Records on the number of bears destroyed under permit from 1980-1986 are not available. In 1986, approximately 70 bears were destroyed under permit.

Damage Abatement and Claim Payments

A governor-appointed committee studied the wildlife damage situation in Wisconsin during 1981 and 1982 and concluded that a wildlife damage program was needed. Consequently, the legislature passed authorization of Wisconsin's present Wildlife Damage Abatement and Claims Program in 1983 (The State of Wisconsin 1984, 1985). The new program was developed to help landowners who experienced damage caused by black bears, white-tailed deer, and Canada geese (*Branta canadensis*). It gives priority to funding of abatement work over payment of claims. The program provides 50% of landowner costs for county-prescribed abatement practices and 100% of county administration costs. Payments for damage claims are pro-rated on remaining fiscal year funds. The WDNR provides funds for the program through a $1 surcharge on all hunting licences, which generates approximately $1 million annually. Administration of the program has been transferred to individual county governments that choose to participate in the program (Figure 3).

Although the present Abatement and Claims Program is administered by state and county agencies, the federal government is also involved in wildlife damage control in Wisconsin. In 1986, the U.S. Congress transferred national responsibility of animal damage control from the Department of Interior - Fish and Wildlife Service (USFWS) to the Department of Agriculture - Animal and Plant Health Inspection Services (APHIS). APHIS's goal is to establish offices and administer damage control programs in all 50 states. The WDNR and APHIS have established a cooperative agreement for goose damage control in Wisconsin, and similar agreements are being developed for black bear and beaver.

Few attempts were made to abate bear damage to apiaries, livestock, orchards for field crops in Wisconsin before 1983. However, interest in fencing and other bear damage abatement techniques increased substantially in the 1980's, with the advent of program funding and educational publications that demonstrate the effectiveness of techniques (Manitoba Department of Natural Resources 1982, Boddicker 1983, Cardoza 1985, Hygnstrom and Craven 1985). The WDNR and University of Wisconsin - Cooperative Extension Service have cooperated to produce 5 training programs on animal damage control and several public information bulletins on bears, animal damage control, and the

Wildlife Damage Abatement and Claims Program (Kohn 1980, 1983; Hygnstrom 1984; Hygnstrom and Craven 1985; Wise 1986). The number of bear abatement projects that were funded by the Abatement and Claims Program between 1983 and 1986 could not be determined because of a flaw in the accounting system.

No bear damage claims were paid under the program between 1983 and 1985 because of insufficient funding. Claims totalling $60,252 ($N=36$) were submitted for bear damage in 1986. Most were for corn (76%), followed by apiaries (22%), cattle (1%), and other (1%). This distribution of claims is substantially different from previous years.

THE FUTURE

Future management of problem black bears in Wisconsin will continue to include regulated harvests, trapping and relocation, shooting permits, and damage abatement and compensation. Interagency cooperation is essential for the development of consistent, effective management programs.

Public Information

A public information program is being developed in Wisconsin to increase public awareness of bears and how to minimize potential conflicts. It will include hunter education programs to promote ethical behaviour of hunters, and maintain bear hunting as a management tool. Bear hunting is susceptible to the anti-hunting movement because of the status of bears, relatively low hunter participation, and problems with behaviour of hunters. Programs should address problems associated with fair chase (trespass, vehicle-assisted hunts, use of dogs and baiting) and ethical harvest (shooting of cubs and sows with cubs).

Research

Research on population dynamics of black bears in Wisconsin is continuing. Information gained will be incorporated into the bear population model to improve population management. Future research in Wisconsin should be directed toward (1) improvement of various aspects of the black bear population model, (2) the impact of hunter distribution and harvest on bear populations and damage control, (3) development of cost-effective damage-control measures in orchards and field crops, and (4) the study of landowner attitudes toward bears and bear damage.

Harvest Management

Conservation groups, sportsman groups, and legislators have supported the WDNR's new black bear hunting permit system. The WDNR will likely change the location and size of bear management zones to increase control of hunter distribution and harvest.

Trapping

The WDNR is currently reviewing its policy on relocating and shooting problem bears. Recent work on homing tendencies has raised questions about trapping and relocating problem bears (Massopust 1984; Massopust and Anderson 1984; Rogers 1985, 1987). In the past, WDNR districts developed their own approaches to handling bear complaints. The present goal is to establish statewide guidelines to define situations when problem bears should be relocated or destroyed.

Damage Abatement and Claims Payment

Implementation of the Wisconsin Wildlife Damage Abatement and Claims Program has faced some hurdles in its 3-year history. Wisconsin legislators established rules to transfer the administration of the program to individual counties in an effort to provide more local control over the program and to reduce administrative costs. Initially, counties were reluctant to become involved in the new program because of problems that were experienced with the previous Wildlife Damage Compensation Program. Political pressure from county constituents has increased statewide enrollment from 18 Wisconsin counties in 1983 to 49 of 72 counties in 1987 (Figure 3). All but 3 of the counties that are located in bear range are enrolled. All high-risk counties should be enrolled so that funds are available for landowners who are most likely to experience bear damage.

SUMMARY AND RECOMMENDATIONS

Changes in bear populations and human land-use have resulted in increased bear-people conflicts in Wisconsin. About half of the complaints are of a nuisance nature. The remainder involve substantial financial loss as a result of bear damage to apiaries, crops, livestock, and buildings. Changes in public attitudes toward bears have led to necessary changes in bear management. Early frontier justice has been replaced by WDNR-administered hunting seasons, trapping and relocation, permit shooting, and landowner assistance programs. Wisconsin's current Wildlife Damage Abatement and

Claims Program provides monetary and technical assistance to landowners who experience bear problems. Public education and research continue to be an important aspect of problem bear management in Wisconsin.

We recommend the following for problem bear management programs:

1. Establish bear management zones that enable resource agencies to control hunter distribution and harvest. Permit hunting can be used to control damage by reducing bear numbers in areas where there is a high potential for bear-people conflicts.
2. Implement bear damage abatement programs, where warranted, that emphasize damage prevention and control. All risk areas should be eligible for cost-share funding to maintain equitability.
3. Promote high-profile public information programs to increase public awareness of bears and how to minimize potential conflicts.
4. Conduct research to determine (1) the impact of hunter distribution and harvest on bear populations and damage control, (2) landowner attitudes toward bears and bear damage, (3) new cost-effective damage control measures, and (4) more accurate survey techniques for black bears.

LITERATURE CITED

ANONYMOUS. 1982. The Wisconsin bear management program. Wisconsin Nat. Resour. Board Rept., Madison. 8 pp. (Mimeo).

BECKER, G. C. 1940. The black bear in Wisconsin. Wisconsin Conserv. Dept., Madison. 26 pp. (Mimeo).

BODDICKER, M. L. 1983. Black bears. Pages C5-C15 *in* R. M. Timm, ed. Prevention and control of wildlife damage. Great Plains Agric. Council and Univ. Nebraska-Extension, Lincoln. 600 pp.

CARDOZA, J. E. 1985. Black bear damage and control in Massachusetts. Massachusetts Div. Fish. Wildl. 11 pp.

CREED, W. A. 1958. Let's show blackie some respect. Wisconsin Conserv. Bull. 23:18-20.

HYGNSTROM, S. E. 1984. Wisconsin's wildlife damage and abatement claims program. Univ. Wisconsin - Extension, Madison. 3 pp. (Mimeo).

_____, and S. R. CRAVEN. 1985. Bear damage and nuisance problems in Wisconsin. Univ. Wisconsin - Extension Pub. No. G3300. 6 pp.

JACKSON, H. H. T. 1961. Mammals of Wisconsin. Univ. Wisconsin Press, Madison. 504 pp.

KNUDSEN, G. J. 1957. What's doin' with bruin? Wisconsin Conserv. Bull. 22:12-14.

KOHN, B. E. 1980. Bear in mind. Wisconsin Nat. Resour. 4:10-13.

_____. 1982. Status and management of black bears in Wisconsin. Wisconsin Dept. Nat. Resour. Tech. Bull. No. 129. 31 pp.

_____. 1983. Wisconsin's bear essentials. Wisconsin Nat. Resour. 7:9-11.

_____. 1985. Bear population indices (survey and inventory). Wisconsin Dept. Nat. Resour. Prog. Rept. PR Proj. W-141-R-20. 8 pp. (Mimeo).

MANITOBA DEPARTMENT OF NATURAL RESOURCES. 1982. Preventing bear damage to beehives. Manitoba Dept. Nat. Resour. Publ. No. MG10351, Winnipeg. 15 pp.

MASSOPUST, J. L. 1984. Black bear homing tendencies, response to being chased by hunting dogs, reproductive biology, denning behavior, home range, diel movements and habitat use in northern Wisconsin. M.S. Thesis, Univ. Wisconsin-Stevens Point. 168 pp.

_____, and R. K. ANDERSON. 1984. Homing tendencies of translocated nuisance black bears in northern Wisconsin. Proc. East Workshop Black Bear Manage. Res. 7:66-73.

ROGERS, L. L. 1985. Effects of translocation distance on frequency of return by adult black bears. Wildl. Soc. Bull. 14:76-80.

_____. 1987. Navigation by adult black bears. J. Mammal. 66:185-188.

SCHORGER, A. W. 1949. The black bear in early Wisconsin. Transact. Wisconsin Acad. Sci. Arts Letters 39:151-194.

SCOTT, W. E. 1947. The black bear in Wisconsin. Wisconsin Conserv. Bull. 12:1-8.

THE STATE OF WISCONSIN. 1984. 29.598 Wildlife damage abatement program; wildlife damage claims program. Pages 769-722 *in* O.C. Prestegard, ed. Wisconsin statutes 1983-1984. The State of Wisconsin, Madison. 5603 pp.

_____. 1985. Subchapter II, wildlife damage. Pages 224 *in* C. L. Prestegard, ed. Wisconsin administrative code II. The State of Wisconsin, Madison. 330 pp.

WISE, S. 1986. The black bear. Wisconsin Dept. Nat. Resour. Pub. No. WM015-85. 4 pp.

NUISANCE BEAR ACTIVITY AND MANAGEMENT IN MINNESOTA

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Abstract: Complaints regarding black bear (*Ursus americanus*) nuisance activity were monitored by Conservation Officers and Wildlife Managers of the Minnesota Department of Natural Resources through a survey conducted during 1981-1987. Nuisance activity was low (<20 complaints/week statewide) during the even-numbered years and high (25-60/week) during the spring and early summer of the odd-numbered years. Five contiguous counties in the northeastern and north-central part of the state accounted for most (62%) of the spring and early-summer nuisance activity and a significant proportion of the yearly variation. May - July nuisance activity in this region was inversely correlated with snow depth in late March. Snow cover at the end of March may affect the survivorship of ants or deer, or the nutritional quality of green vegetation, the primary foods of bears from emergence from dens until mid-July. During August and September, nuisance activity in northeastern Minnesota appeared related, in part, to abundance of wild fruits. Good fruiting success in 1982-1984 was associated with few late-summer and fall bear complaints, whereas poor fruiting success in 1985 prompted the worst nuisance year on record. The following year, however, fruits were abundant but nuisance activity remained high, possibly due to conditioning of bears to human-related food sources, an increasing number of bears, or other factors not clearly understood. Most complaints involved disturbance to garbage and/or a perceived threat of injury, although beehive damage accounted for the greatest monetary loss (about $10,000 of the $30,000 total annual damage assessment). Corn damage was high in some years as a result of increased numbers of bears in agricultural areas. Translocation was the preferred method of removing nuisance bears, but more nuisance bears were killed during 1981-1987 ($N > 1,684$) than relocated ($N = 755$). Most killing was done by private individuals, who legally may kill bears to protect property. Most nuisance bears killed or trapped were males (72%). Three-year-olds and bears 10+ years old of both sexes appeared to be over-represented among killed and trapped nuisance animals, compared to the relative abundance of these age groups in the living population. Resolution of conflicts between bears and people in Minnesota involves mainly removing individual nuisance animals and increasing hunting pressure in areas with persistent nuisance problems. A greater emphasis on public education is needed.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Conflicts between people and black bears likely occurred since humans first inhabited North American forests. Schorger (1949) documented bear-people conflicts in colonial America and noted a relationship between scarcity of berries and nuts and increased bear damage to crops, livestock, and other human food sources. Damage to property caused by bears, as well as threats or perceived threats of damage or personal injury, are herein referred to as nuisance activity.

Some parts of Minnesota experience relatively frequent failures of bear food and appreciable nuisance activity. Escalating bear depredations on sheep and beehives in northern Minnesota prompted bounty payments for bears beginning in 1945 (Morse 1946). That year a large number of bears entered Duluth, apparently in response to a berry shortage (Schorger 1946). Four years later there was a massive influx of bears into several northern Minnesota communities (Petraborg et al. 1949). During August 1949, 25 bears were killed within the Duluth city limits. Feeding stations were established just outside the city in an attempt to stem the influx. Statewide 1,134 bears were recorded killed. Nuisance activity diminished in subsequent years, but reports continued of occasional bears entering Duluth during 1950-1953 (Petraborg 1953, 1954).

Bounty payments represent the only record of the number of bears killed through the 1950's ($\bar{x} = 156/\text{yr}$). Most counties discontinued the bear bounty in 1960. However, Game Wardens estimated that 700 - 900 bears were killed annually during 1960-1963, indiscriminately or as a result of nuisance activity, in addition to an annual take of 200 - 1,000 bears by trappers and deer hunters (Minn. Dept. Nat. Resour., unpubl. rep., 1964).

In 1971 bears were classed as a game animal in Minnesota, giving them legal protection from indiscriminate killing, although they still could be killed if they damaged or threatened property. The reported nuisance kill remained fairly stable from 1975 to 1980, except for the poor food year of 1978 (Figure 1). A poor food year in 1981 spurred another high nuisance kill which, combined with a high and steadily increasing harvest (Figure 1), prompted a quota to limit the number of bear hunting licences, a system which has continued to date. This quota gives the Minnesota Department of Natural Resources (MDNR) direct control over the hunter harvest (Garshelis 1986), but high nuisance kills continue to be a problem.

In 1981, the MDNR initiated a study to determine relationships between temporal and geographic trends in

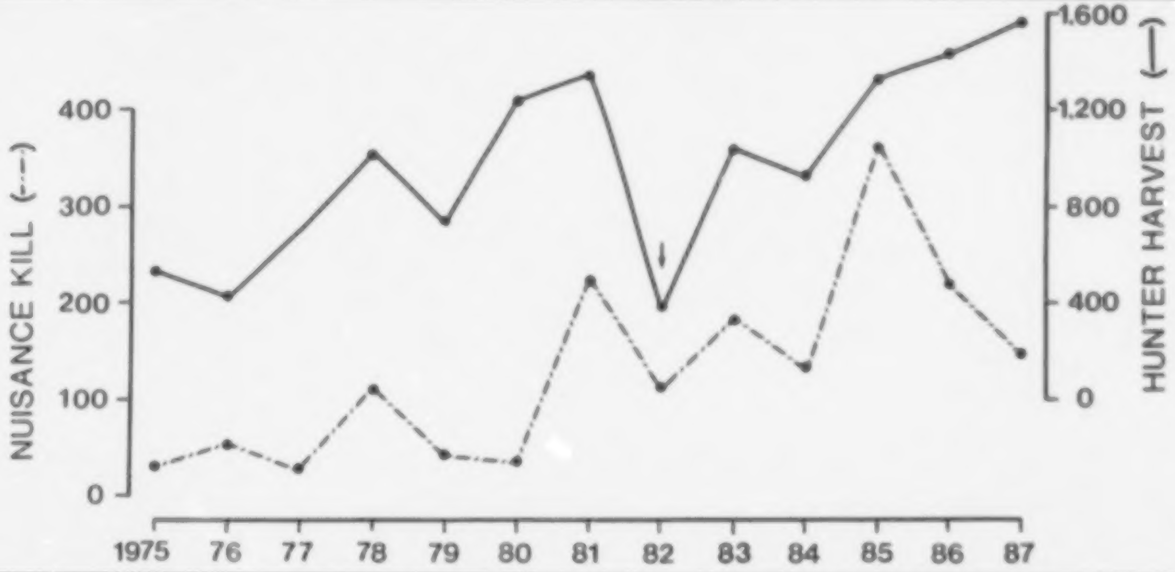

Figure 1. Number of Minnesota black bears killed as nuisances (based on confiscation records) and number killed in the fall hunt (based on number registered). Beginning in 1982, the harvest was restricted by a licence quota, and the harvest was severely reduced (arrow on top curve). Licence quotas were continued but increased during 1983-1987.

nuisance activity and factors such as food availability, weather, and bear density. The study also was designed to document the types and extent of damage caused by bears, the ways in which the general public and MDNR personnel respond to and deal with nuisance bears, and the sex and age structure of nuisance bears. This paper reports results of this study obtained during 1981-1987.

The study was initiated by C. Kinsey and P. D. Karns. I thank K. V. Noyce for her help in conducting the survey and interpreting results. I also thank W. J. Snow for computer analysis, P. L. Coy for data tabulation, and J. A. Summers for typing the manuscript and the many preliminary reports that preceded it. Helpful criticisms of the manuscript were provided by D. Kuehn, R. Lake, S. Miller, and K. Noyce. I am especially grateful to the many MDNR field people who took part in the survey and who spent numerous hours investigating and attempting to reconcile human-bear conflicts throughout the state. This study was funded by the MDNR, with additional support to participate in the symposium provided by Safari Club International, Minneapolis.

STUDY AREA

An estimated 8,000 - 10,000 black bears occupy approximately 80,000 km^2 of northern Minnesota (primary range, Figure 2). The primary bear range is dominated by aspen (mostly *Populus tremuloides*) and paper birch (*Betula papyrifera*), with maple (*Acer rubrum* and *A. saccharum*) and balsam fir (*Abies balsamea*) as common associates. Large expanses of the bear range are covered by black spruce (*Picea mariana*), sometimes in association with tamarack (*Larix laricina*) and/or white cedar (*Thuja occidentalis*).

Most of the primary bear range lies on thick deposits of glacial till, characterized by moderately developed soils of low to medium fertility. The northeastern corner of Minnesota lies predominantly on the Canadian Shield, with thin, low-fertility soils supporting forests dominated by aspen and pine (mainly *Pinus banksiana*). The peripheral bear range (Figure 2) has high soil fertility and supports extensive agriculture (mainly corn), with pockets of forest that include the principal concentrations of oaks (*Quercus* spp.) in the state. Approximately 4,000 km^2 of primary bear range are cultivated, as is at least an equal area within the peripheral range.

This study was conducted throughout the entire bear range, including private (17% of primary range, 72% of peripheral range), county (23% vs. 4%), state (33% vs. 17%), and federal lands (21% vs. 3%). Indian Reservation lands (4% of primary, 2% of peripheral) and Voyageurs National Park (540 km^2) were not included. Most of northeastern Minnesota and much of

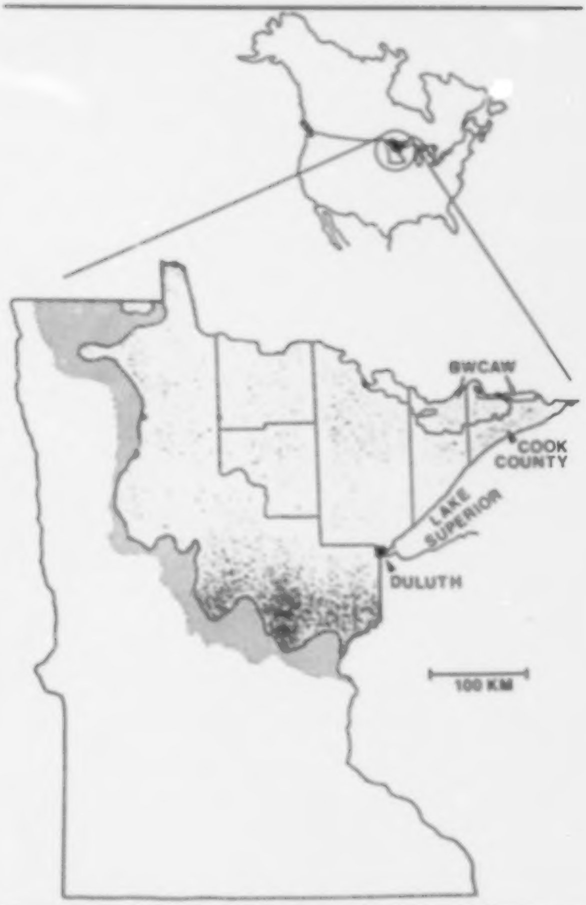

Figure 2. Primary (forested) black bear range in Minnesota (dark shading), and peripheral range (coarse stipple), which includes mainly agricultural lands. Boundaries of 5 north-central and northeastern counties and the Boundary Waters Canoe Area Wilderness (BWCAW) are shown.

north-central Minnesota are within the Superior and Chippewa National Forests, areas that support extensive outdoor activities and hence high human use during summer. Resident human population densities ranged from 1 - 16 people/km^2 in counties within the primary bear range. There are 7 cities with populations >10,000, the largest being Duluth (80,000 people, Figure 2).

The average freeze-free season lasted 143 days along the shore of Lake Superior to 88 days further inland (Baker and Strub 1963). Average snowfall was >125 cm throughout the primary bear range, and the mean duration of snow cover ranged from 110 - 160 days (November - March or April) (Baker et al. 1967, Kuehnast et al. 1982).

METHODS

During 1981-1985, MDNR Conservation Officers ($N = 70$) and Wildlife Managers ($N = 13$) stationed within the bear range were given forms on which they were requested to report the following information related to each nuisance bear complaint they investigated: date and place of the complaint, reason for the complaint, damage cost estimate, preventive measures suggested and undertaken, and the number and sex (if determined) of bears seen, trapped, and killed. A separate form was required for each complaint investigated. Forms also were completed if a bear was reported killed but the site was not investigated.

In 1984 and 1985, Officers and Managers also were asked to tally the number of phoned-in complaints received each month to enable determination of the percentage of complaints that were investigated. Because tallies were requested even if no complaints were received, the rate of participation in the survey could be determined from the number of monthly tallies submitted.

Poor participation in the survey prompted a more simplified reporting procedure in 1986 and 1987. A form was developed on which could be listed the date, place, type of complaint, number of bears present, and number of bears trapped and killed at each nuisance site investigated each month (killed bears were listed even if the site was not investigated). The monthly tally of phoned-in complaints was discontinued, but the new survey forms were to be returned even if no complaints were investigated, thus enabling continued assessment of survey participation by field personnel. Participation was encouraged but not required.

Survey participants also were asked to extract a first premolar from dead nuisance bears, and one Wildlife Manager extracted teeth from trapped nuisance bears. Teeth were sectioned and used for age estimation. The age structure of these bears was compared to the age structure of the living population, which was estimated from a population model (available upon request). Using data from statewide harvest statistics (including the sex and age structure of the harvest) and an intensive capture-telemetry study (Garshelis et al. 1988), the model generated population age structures for 1981-1987. The percentage of bears in each age class was averaged across these years to obtain a generalized age structure representative of the period of study.

In conjunction with the nuisance bear survey, a survey of bear food abundance was conducted during 1982-1987 to

Table 1. Percentage of Minnesota Department of Natural Resources field personnel returning nuisance bear survey forms.[a]

Year	Apr	May	Jun	Jul	Aug	Sep	Oct
1984	--[b]	27	41	39	30	18	5
1985	21	35	45	37	32	28	24
1986	46	65	64	63	58	57	40
1987	54	86	90	78	75	63	45

[a] During years shown, forms were to be returned even if no complaints were received.

[b] Participation hampered by late distribution of forms.

Table 2. Mean number of black bear nuisance complaints recorded on each monthly survey form by Minnesota Department of Natural Resources field personnel.[a,b]

Year	Apr	May	Jun	Jul	Aug	Sep	Oct
1984	nd[c]	3.2	4.4	4.4	4.5	2.5	1.5
1985	1.4	2.7	6.9	9.2	12.2	6.6	2.3
1986	0.5	0.8	1.7	1.4	4.0	3.3	0.8
1987	0.3	1.3	2.5	3.6	1.9	2.2	0.6

[a] During years shown, forms were to be returned even if no complaints were received.

[b] Values indicate trends in nuisance complaints across months but not across years, because in 1984 and 1985 all phoned-in complaints were tallied on monthly survey forms, whereas only those actually investigated were recorded in 1986 and 1987.

[c] nd = no data.

determine the relationship between food availability and nuisance activity. Wildlife Managers and Foresters (MDNR, U.S. Forest Service, and county personnel; $N = 20 - 60$) evaluated the abundance and productivity of 14 wild food-bearing plants in their work areas. The choice of plant species surveyed was based on food habits studies conducted by the MDNR (Garshelis et al. 1988) in the central part of the Minnesota bear range, and by L. L. Rogers (pers. commun.) in northeastern Minnesota. Results of the food survey are discussed herein only as they pertain to bear nuisance activity; a more detailed description of the analyses and results were presented by K. V. Noyce (Summary of bear food surveys, MDNR unpubl. rep., 1988).

Weather records were obtained from Climatological Data, Minnesota (1981-1987, Nat. Oceanic and Atmos. Adm., Nat. Climatic Data Center). Additional data, including snow depth, were available from a MDNR survey of winter weather conditions at 21 stations throughout the bear range. Indices of soil moisture were obtained from Weekly Weather and Crop Bulletins (1981-1987, U.S. Dept. Agric. and U.S. Dept. Commerce).

RESULTS AND DISCUSSION

Survey Participation

Survey participation varied by month, by year, and among field personnel. A questionnaire inquiring about reasons for lack of participation indicated that 60% of those who at some time neglected to submit a form simply forgot to do so when they had no complaints. Thus, participation was low during April (Table 1) when the average number of complaints listed per survey form was low (Table 2). Complaints per form increased through June, as did survey participation.

Participation waned in July and August (Table 1) despite high nuisance activity in some years (Table 2), apparently (according to the questionnaire) because of a lack of time; dealing with nuisance bears and other enforcement problems took precedence over paperwork. By September and October nuisance activity diminished and survey participation continued to decline.

The variable participation in the survey across years hindered an analysis of the factors contributing to yearly variation in nuisance activity. The reported number of complaints could be adjusted by participation in the survey; but such an adjustment would be biased high at times when there were few complaints and a disproportionately large number of personnel simply forgot to fill out survey forms. Correspondingly, this adjustment would be biased low during periods of extremely high nuisance activity when submitted survey forms may not have included all complaints actually received. Furthermore, participation could be assessed only during 1984-1987, when monthly reports were requested even if no complaints were received.

A less biased adjustment to the number of reported complaints is the percent of nuisance bear kills that were reported on the survey. If a Conservation Officer or Wildlife Manager investigated the site where a nuisance bear was killed (or if they actually killed one), they were required to sell or dispose of the bear and give it a confiscation number. These confiscation numbers were entered into a record separate from the nuisance bear survey. Because this record keeping was mandatory, it could be used as a standard by which the reported nuisance number of kills on the nuisance survey could be compared. There was no apparent relationship between nuisance activity and the percent of confiscations that were reported on the survey, corroborating the validity of nuisance kills as an adjustment factor.

In 1987, when participation in the survey was more strongly encouraged than in previous years, there were more nuisance kills reported on the survey than tabulated in confiscation records. This resulted from situations when a Conservation Officer or Wildlife Manager recorded a nuisance kill on the survey based on a phoned-in report, but did not go to the site to confiscate the bear. Presumably, in years prior to 1987 a similar percentage of the phoned-in kills were not confiscated. The estimated number of phoned-in kills not confiscated was added to the number of confiscations to yield an estimate of kills known to field personnel. The percentage of these known kills that were recorded on the nuisance survey was used as an adjustment factor for the number of reported complaints (Table 3).

Adjustments to account for year-to-year variation in the survey participation ranged from 56% to 66% (with 1987 set at 100%). The number of reported complaints was divided by the adjustment factor for all analyses considering potential factors influencing year-to-year variation. Due to the possible biases in a data set generated through variable survey participation, and the further uncertainties in the associated correction factors, statistical tests were used only sparingly to examine correlations and trends. Where statistical procedures were used, both adjusted and unadjusted data sets were tested, and correction factors were found not to alter the basic trends observed.

Temporal Trends

Spring - Early Summer • In all years, bear nuisance activity was low during April and early May. Complaints increased in mid-May, but levelled off at <20 complaints/week statewide during June and July of 1982, 1984, and 1986. In the odd-numbered years, however, nuisance complaints continued to increase in June and July, with 25 - 60 complaints investigated weekly.

Five contiguous counties in north-central and northeastern (NC-NE) Minnesota (Figure 2) accounted for a mean of 62% (range 45 - 83%) of the nuisance complaints during May - July, 1981-1987, and 86% of the year-to-year variation in complaints during these months ($F=30.1$, $P=0.002$). No other counties showed the every-other-year pattern in May - July nuisance activity.

Table 3. Number of black bear nuisance kills reported on Minnesota Department of Natural Resources nuisance survey forms, compared to the estimated number of kills that were known to field personnel.

Nuisance kill	1981	1982	1983	1984	1985	1986	1987
A. Confiscated	226	112	185	130	364	221	121
B. Not confiscated[a]	54	27	44	31	87	53	29
C. Known to field personnel (A+B)	280	139	229	161	451	274	150
D. Recorded on survey[b]	186	78	138	101	258	155	150
E. Percent recorded on survey[c] (100D/C)	66	56	60	63	57	57	100

[a] The number of kills phoned-in by private parties but not confiscated by field personnel was estimated for 1981-1986 using data from 1987. A minimum estimate of the number of phoned-in kills not confiscated in 1987, when participation in the survey was exceptionally good and reported kills exceeded confiscations, is the difference between the number of kills reported on the survey and the number confiscated (150-121=29). This value as a percentage of the confiscations in 1987 (29/121=24%) was used to estimate the number of phoned-in kills not confiscated in other years.

[b] Excludes those taken by licenced hunters.

[c] Percent of kills reported was used to adjust the number of complaints reported each year, due to varying survey participation.

Variations in food and weather were posited as possible causes of variation in May - July nuisance activity. Changes in the size and structure of the bear population were discounted as the primary source of variation in spring-summer nuisance activity. The population appeared to be growing steadily during the term of this study (Garshelis 1986), and although reproductive synchrony (Free and McCaffrey 1972) was evident in the harvest age structure, particularly in the 5 NC-NE counties, it did not consistently match the apparent every-other-year pattern in nuisance complaints.

Fall food availability fluctuates widely in northern Minnesota. None of the major fall foods persist until spring, but fall food supply may affect nutritional status during hibernation, and thus conceivably could affect the amount of spring nuisance activity. However, no relationship between abundance of fall food and subsequent spring-summer nuisance activity in the 5 NC-NE counties was observed. In fact, the year of greatest abundance of fall food (a bumper crop of beaked hazelnuts [*Corylus cornuta*] in 1984) was followed by the highest recorded spring-summer nuisance activity in the NC-NE counties.

Winter temperatures appeared unrelated to nuisance activity the following year, but a significant inverse relationship was noted between snowfall and nuisance complaints. Heavy snow may provide greater insulation for some denned bears, resulting in better physiological condition upon emergence from dens. However, snow depth during the coldest winter months had no relation to subsequent nuisance activity, whereas snow depth the last 2 weeks of March accounted for 64% of the yearly variation in May - July nuisance complaints ($F=8.7$, $P=0.02$) in the 5 NC-NE counties. Spring-summer nuisance activity was high in years with little snow in late March (Figure 3). This pattern continued (deep snow, few complaints) in 1988.

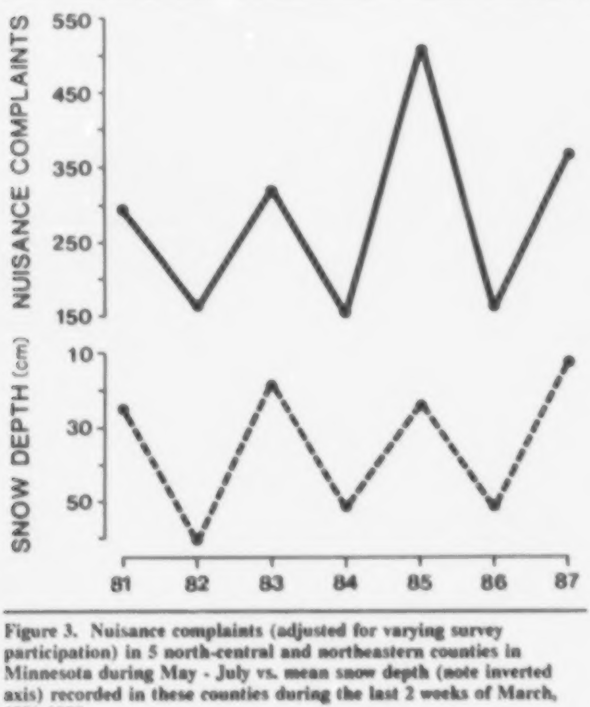

Figure 3. Nuisance complaints (adjusted for varying survey participation) in 5 north-central and northeastern counties in Minnesota during May - July vs. mean snow depth (note inverted axis) recorded in these counties during the last 2 weeks of March, 1981-1987.

An earlier exit from dens could explain the high incidence of bear nuisance activity in years with little snow in late March. Although dates of den emergence of radio-collared bears in north-central Minnesota (typically late March - early April, MDNR unpubl. data) showed no obvious correlation with snow cover, bears in northeastern Minnesota apparently emerged earlier when there was little snow left in late March (Rogers 1987). If bears left dens earlier when there was little snow, they may have experienced elevated metabolic rates and consequently required more food than when they emerged later.

An alternate hypothesis is that snow depth in late March affected the quantity and/or quality of foods during spring and early summer. During this period, bears consumed primarily green vegetation and ants, but remains of deer (*Odocoileus virginianus*) also have been found in their scats (Rogers 1987, Garshelis et al. 1988). A positive relationship between winter snow depth and fawn mortality in Minnesota has been documented (T. K. Fuller, M.S. in prep.). Winter-killed deer thus would be more available to bears in early spring following winters with deep snow. Additionally, wolves (sympatric with bears in much of Minnesota) kill more deer (Nelson and Mech 1986) but consume less of each carcass when snow is deep (Pimlott et al. 1969, Mech et al. 1971), thus providing more scavenging opportunities for bears.

Green vegetation comprised a much larger proportion of the spring and early-summer diet of bears in Minnesota than carrion, so it would seem reasonable that the quality or abundance of certain plants might have more impact on bear nuisance activity. Quality and abundance of green vegetation is likely affected by rainfall, but there was no apparent relationship between bear nuisance activity and rainfall or soil moisture during April - July.

Ants constituted 44 - 66% of the diet from mid-June through July (Garshelis et al. 1988), a period exhibiting greater yearly fluctuations in nuisance activity than May - early June, when bears consumed primarily (>80%) green vegetation. This suggests that relationships between early spring snow depth, ant abundance, and bear nuisance activity warrant investigation.

Late Summer - Fall • Year-to-year fluctuations in late summer and fall nuisance activity were most pronounced in northeastern Minnesota. The 3 northeastern counties accounted for 26 - 71% ($\bar{x}=48\%$) of nuisance complaints during August - October and a significant portion (82%) of yearly variation in complaints ($F=22.4$, $P=0.003$). This area exhibits the largest fluctuations in availability of wild fruits, the chief late summer-fall food for bears, and has the lowest overall diversity of fruits (Noyce, unpubl. rep., 1988). Therefore, it was not surprising to find an inverse relationship between nuisance activity and availability of a few key fruits during August ($r^2=0.95$, $F=39.8$, $P=0.02$) and September ($r^2=0.98$, $F=131.6$, $P=0.008$) in northeastern Minnesota during 1982-1985 (Table 4). Low nuisance activity during August 1983 reflected a bumper crop of juneberries (*Amelanchier arborea*) and blueberries (*Vaccinium* spp.), whereas a blueberry failure in August 1985 apparently spurred high nuisance activity. Rogers (1976) noted a correlation between nuisance activity and abundance of blueberries in Wisconsin. Likewise, a bumper crop of hazelnuts and mountain ash (*Sorbus* spp.) in September 1984 was correlated with minimal nuisance activity, whereas a poor crop of these fruits in 1985 was associated with a large number of bear complaints (Table 4).

Table 4. Number of nuisance bear complaints[a] in northeastern Minnesota vs. mean abundance of some key foods in that area.[b]

	1982	1983	1984	1985	1986	1987
August complaints	27	9	21	98	87	46
Abundance of blueberries	2.0	2.6	2.1	1.0	2.5	0.9
September complaints	21	28	0	38	156	29
Mean abundance of 3 primary fall foods[c]	2.0	1.6	2.6	1.3	1.9	2.3

[a] Complaints were adjusted for varying survey participation by the percentage of nuisance kills known to field personnel that were reported on nuisance survey forms (as shown in Table 3, except that adjustments were calculated specifically for northeastern Minnesota).

[b] 4-16 field people in this area rated abundance on a 0-4 scale, 2 = average.

[c] Hazelnut, mountain ash, and dogwood (*Cornus* spp.)

Numbers of nuisance complaints in Duluth during August and September 1985 were comparable to those reported during the "bear influx" of 1949. During late summer-fall, bears in northeastern Minnesota often moved south toward the shore of Lake Superior (Rogers 1987), where soils are richer and food tends to be more abundant (Noyce, unpubl. rep., 1988). More bears likely made these southward seasonal movements during years of poor food. Thus, the widespread fruit failure in northeastern Minnesota in 1985 may have prompted increased southerly movements of bears, which were subsequently shunted to Duluth by Lake Superior (Figure 2).

The relationship between food abundance and late summer-fall nuisance activity in northeastern Minnesota did not persist in 1986 and 1987. Although abundance of primary foods was average or above average in 1986, nuisance complaints were high in August and reached record high levels in September (Table 4). Similarly, in August and September 1987 there were more nuisance complaints than expected in northeastern Minnesota, where fruit production was about average for all species except blueberries (K. V. Noyce, unpubl. rep., 1988).

Higher-than-expected nuisance activity in 1986 and 1987 may have been attributable to increased attraction of bears to human-related food sources due to conditioning during the food shortage of 1985. In the southeastern corner of the bear range, many bears apparently became conditioned to feeding on corn, which likely contributed to record numbers of nuisance complaints in this area during August - September 1986. The problem there likely was exacerbated by increased planting of early-ripening varieties of corn and an increased density of bears.

Types and Extent of Damage

Most bear complaints in Minnesota involved disturbance of garbage and/or a perceived threat of human injury (Table 5). Perceived threat of injury was listed as the sole reason for complaint in 8 - 13% of the cases investigated each year. Disturbance of garbage was the chief complaint during all months (Figure 4) and was cited in half the complaints during July. Most of these problems were caused by infrequent or improper disposal of garbage.

Damage to beehives accounted for the single greatest monetary loss from bears, averaging about $10,000/year. This was considerably less than beehive damage estimates reported from Florida ($100,000/yr) (Maehr and Brady 1982) and Alberta ($200,000/yr) (Gunson 1979). Nevertheless, some Minnesota beekeepers experienced significant bear damage (up to $2,000), most of which could have been averted with electric fencing.

The percent of complaints involving damage to beehives varied markedly among years (Table 5). In 1985, relatively little damage to hives occurred because for most of the year nuisance activity was concentrated in northeastern Minnesota, where beekeeping is not common. Conversely, beehive damage was particularly high in 1981 because nuisance activity was centered in agricultural areas, which support more apiaries. Within a given year, attraction of bears to beehives seemed fairly constant from May through August (Figure 4), although Lord and Ambrose (1981) and Maehr and

Table 5. Reasons cited for complaints regarding black bears in Minnesota, showing percent of complaints tallied.[a] [b]

Reason for complaint	1981 (602)[b]	1982 (243)	1983 (543)	1984 (251)	1985 (669)	1986 (583)	1987 (789)
Threat of injury	37	53	55	43	46	32	40
Garbage disturbance	38	41	46	50	49	36	51
Damage to beehives	13	4	8	9	4	7	4
Livestock threat/loss	10	10	13	8	7	7	7
Campground nuisance	6	6	9	10	8	6	9
Crop damage	17	6	6	12	18	24	4
Other property damage	21	35	40	33	30	26	35

[a] Percentages total over 100% because multiple reasons were often listed.

[b] Total unadjusted complaints shown parenthetically.

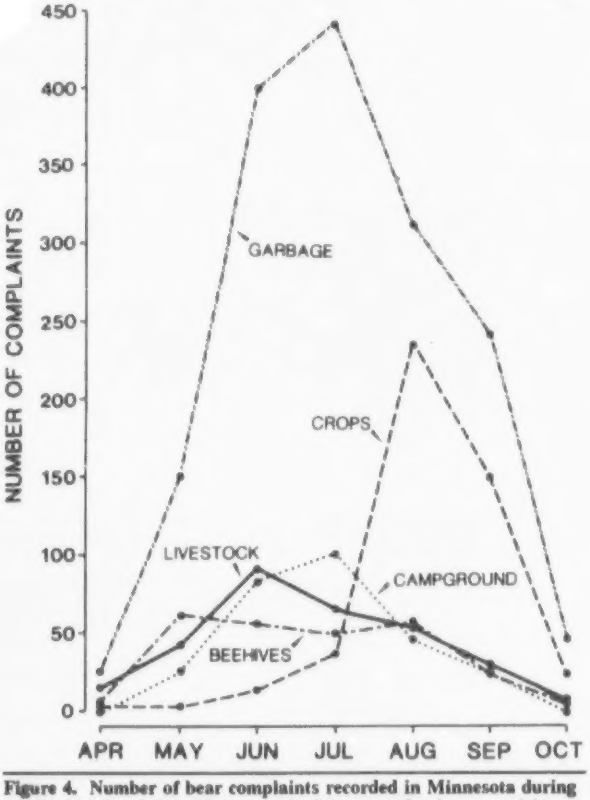

Figure 4. Number of bear complaints recorded in Minnesota during April - October 1981-1987, categorized by type of nuisance activity. Not all types of nuisance activity are shown (see Table 5).

Brady (1982) reported a distinct May - June peak in beehive depredations by bears in North Carolina and northern Florida.

The percentage of complaints involving bears threatening or killing cattle and sheep was fairly stable from year to year (Table 5). Mean annual livestock loss totalled about $3,000. Most livestock depredations occurred in June (Figure 4), although only about 11% of bear complaints in June involved livestock, compared to 17% of the April complaints (percentages are medians over the 7 years). Horstman and Gunson (1982) observed a similar June - July peak in cattle depredations by bears in Alberta, although Jorgensen et al. (1978) reported wide variation in the seasonality of livestock depredations across the range of black bears in North America.

Nuisance bears in campgrounds constituted 6 - 10% of the complaints in Minnesota each year (Table 5). The chronology of campground nuisance activity (Figure 4) probably matched the pattern of campground use by people. One of the most serious problems was in the Boundary Waters Canoe Area Wilderness (Figure 2), where it is difficult to protect food from bears because motorized vehicles are prohibited and bear-proof containers are not provided at campsites.

Crop damage occurred mainly in August and September (Figure 4), coinciding with the ripening of corn, oats, and apples, the principal crops (in descending order) damaged by bears. In 1981, 1985, and 1986, when bear nuisance activity in August and September was high in agricultural areas, 17 - 49% of the complaints recorded during these months involved crops. Crop damage averaged nearly $6,000 annually. As noted by Davenport (1953) and Spencer (1955), most crop damage from bears is due to trampling and breakage rather than consumption.

Total annual damage caused by bears in Minnesota averaged about $30,000. The State's policy against compensating for bear damage seems to foster resentment against bears by those who have experienced significant losses. However, agencies that do compensate for bear depredations sometimes find it difficult to verify the legitimacy of claims (Jorgensen et al. 1978).

Dealing with Nuisance Bears

About 80% of bear complaints reported to the MDNR are handled by Conservation Officers. In the 2 years (1984 and 1985) in which all phoned-in complaints were tallied, 41% were actually investigated on-site by MDNR personnel. Measures to reduce nuisance bear activity were suggested at 70% of the sites investigated, and landowners followed these suggestions 86% of the time. In 34% of the cases, problems ceased without the removal or attempted removal of the bear(s).

Although translocation was the preferred method of removal, killing was necessary when a bear would not enter a trap (56% of trapping attempts were unsuccessful), when there were insufficient traps or personnel to deal with the number of nuisance bears, or when good release sites were not available within a reasonable distance. For example, 65% of the nuisance bears relocated during 1981-1987 (490/755) were from 3 heavily forested northeastern counties, which have many places to release translocated bears; only 45% of all bears killed were from these counties. In contrast, 2 agricultural counties accounted for only 3% (24) of all translocations, but 19% of the nuisance kill.

Of the total number of nuisance bears (not complaints) tallied on this survey each year, 17 - 29% were killed and 11 - 20% were captured and translocated (Table 6). However, many more nuisance kills were known to field personnel (total estimated $N=1{,}684$) than were reported on the survey ($N=1{,}066$, Table 3). Additionally, many bears were killed by private individuals and not reported (possibly as many as were reported, according to some field personnel).

Table 6. Removal of black bears from complaint sites, based on Minnesota Department of Natural Resources nuisance bear surveys.

	1981	1982	1983	1984	1985	1986	1987
Total nuisance bears	768	281	772	366	1,025	982	976
Percent killed by:							
Official personnel	18	13	4	7	6	3	3
Private parties	6	15	14	21	20	12	12
Hunters[a]	0	0	0	1	2	2	2
Percent moved	15	20	19	14	11	13	16

[a] Program for hunters to take nuisance bears before the start of the bear season was initiated in 1984. In all years, a small number of nuisance bears (<1%) were removed by hunters during the hunting season (1 Sep. - mid-Oct.).

In 1981, most of the nuisance bears killed and reported in this survey were shot by MDNR personnel (Table 6). In more recent years, however, private individuals killed more nuisance bears than did MDNR personnel. Anyone in Minnesota may kill a bear to protect property, without prior permission, but they must report the killing within 48 hours. Conservation Officers confiscate and sell a limited number of the nuisance bears that are destroyed. To promote the use of nuisance bears that must be killed, the MDNR initiated a program in 1984 whereby licensed hunters could take a nuisance bear before the regular hunting season (but then not also during the season), if authorized by a Conservation Officer. About 2% of the nuisance bears (up to 13% of the nuisance bears killed each year) were taken by hunters (Table 6), mainly before the hunting season (1 September - mid-October).

Sex and Age of Nuisance Bears

Sex was determined for 592 nuisance bears, of which 72% were males (yearly variation = 68 - 74%). Males also comprised a majority of the bears killed during the hunting season, but the sex ratio in the harvest (50 - 64%) was not nearly as skewed. Compared to their representation in the living population (42 - 48% as judged through modelling), males were over-represented among nuisance bears and bears killed in the fall hunt.

Radio-collared males in north-central Minnesota ($N=105$) had a 9% annual mortality rate as a result of nuisance activity, whereas no radio-collared females ($N=82$) were killed as nuisances (Garshelis et al. 1988). Greater mobility and perhaps greater boldness predispose male bears to become nuisances, and their larger size may make them more likely to be killed when involved in conflicts with people. The preponderance of males among nuisance bears appears to be universal (Davenport 1953; Erickson et al. 1964; Piekielek and Burton 1975; Rogers et al. 1976; Horstman and Gunson 1982).

Some authors indicated that old males were involved in nuisance activity more often than young ones (Davenport 1953; Erickson et al. 1964). In contrast, Rogers et al. (1976) found that 68% of the males (excluding cubs) captured in campgrounds or residential areas in northern Michigan were 1 - 3 years old. Horstman and Gunson (1982) reported that livestock-depredating bears were older (only 29% were 1 - 3 years old) than those taken at apiaries (54% 1 - 3 years old).

In Minnesota there was a significant difference in the ages of nuisance bears that were captured versus those that were killed. A higher proportion of the trapped nuisance bears were yearlings (X^2 -tests, $P<0.01$ for each sex), probably indicating a lesser fear of small bears by the public, and a greater hesitancy to kill bears that were often mistakenly perceived to be cubs of the year. Given the under-representation of yearlings among bears that were killed, and the under-representation of older bears among those that were trapped (because they were killed instead), an age structure composed of trapped and killed bears combined is likely more representative of the true age structure of bears involved in nuisance activity.

The pooled age structure of trapped and killed nuisance bears indicated that 57% of the males ($N = 277$) and 30% of the females ($N = 109$) were 1 - 3 years old. Within this age group, only 3-year-olds were over-represented compared to their proportion in the living population (Figure 5). Telemetry data from north-central and northeastern Minnesota indicated that all males disperse from their natal home range, generally when 2 or 3 years old (Rogers 1987, Garshelis et al. 1988). Because dispersing animals typically travel across large, unfamiliar areas, they likely encounter and may even seek out unnatural food sources more often than bears settled in smaller home ranges, where sources of natural food are more familiar. Females do not disperse, however, so their proclivity to become nuisances when 3 years old may indicate that bears simply acquire a greater boldness toward humans or have a greater need for supplementary food sources at this age.

Among females (and possibly males as well), bears >6 years old (especially those 10+ years old) were captured or killed as nuisances more frequently than expected from their representation in the living population (Figure 5) or their representation in the harvest. These older individuals may have been nuisance bears for several years, and eventually had to be trapped or killed.

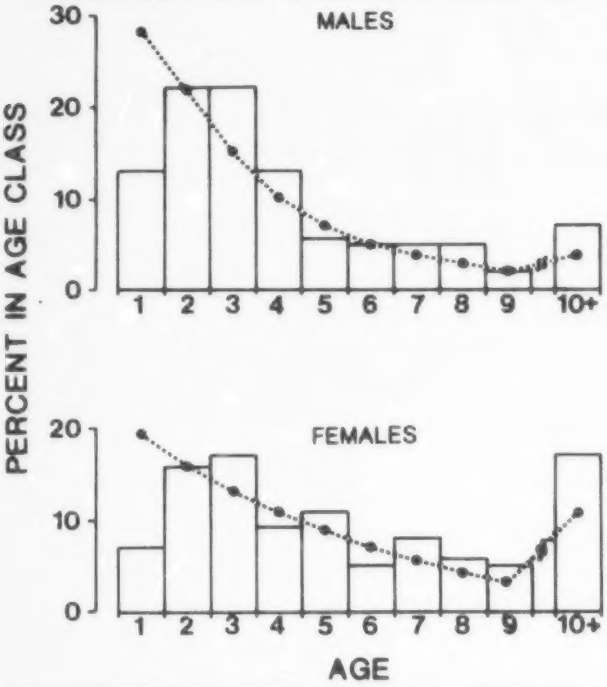

Figure 5. Age structure of nuisance bears that were killed or trapped (bars) ($N = 277$ males, $N = 109$ females) vs. age structure of male and female segments of the living population (dotted curves). The age structure of the living population was estimated from a population model. Bars above the curves indicate age groups that were over-represented as nuisance animals; bars below the curves indicate under-represented age groups.

MANAGEMENT CONSIDERATIONS

Two decades ago Kinsey (1965:198) wrote: "Crop and stock depredations by bears have never been very important in Minnesota. The principal bear range and main agricultural areas of the state are quite well separated". Bear-people conflicts in Minnesota are now so common that some MDNR enforcement personnel spend as much as 90% of their time during the summer months handling nuisance bear complaints (MDNR records). In recent years >5,000 person-hours have been spent annually. In some areas, nuisance kills have exceeded the legal harvest and local residents have come to view black bears as unwanted pests.

Present management involves mainly removal (destruction or translocation) of problem bears and increased hunting pressure, through regulation of licence quotas, in management units with persistent nuisance activity. In 1987 quotas for hunting licences in parts of the primary bear range were increased by as much as 50%, and quotas were removed entirely along the agricultural periphery of the range to increase hunting pressure and stem the apparent growth in bear numbers and nuisance activity. Increased hunting effort helped reduce forest damage by black bears in Washington (Poelker and Parsons 1980), but increased hunting was not effective in reducing other types of bear damage in Alberta (Pelchat 1982).

Relocation of nuisance bears is a common practice among state and provincial agencies, as well as in National Parks. Variable results have been achieved, depending largely on transplant distance (see review by Rogers [1986]). Questions have been raised about the effectiveness of transplant programs in reducing nuisance activity. Transplant operations are relatively expensive compared to killing, and relocated bears may cause problems while attempting to return home or after they return (Massopust and Anderson 1984). However, some have argued that, in general, transplants effectively reduce or at least delay further nuisance activity, enabling nuisance bears to be harvested and used during the hunting season (Alt 1980; Fies et al. 1987). Although the effectiveness of the transplant program in reducing nuisance activity in Minnesota has not been adequately evaluated, it has much greater public support than killing.

A basic argument against transplanting a bear is that it "fails to address the situation that led to its nuisance behavior" (McArthur 1981:109). In Minnesota, field personnel generally attempt to convince landowners to rectify the problem-causing situation before a transplant is attempted, or at least afterwards to reduce the chance of continued problems in the event the relocated bear returns. Such on-site education appears to be effective, but more widespread education is necessary.

Education should focus on ways to reduce access by bears to human-related food sources such as garbage and apiaries. Crops and livestock are more difficult to protect. Public education should also stress the necessity for a greater degree of tolerance to occasional property damage from bears. Additionally, because many bear complaints in Minnesota are based on fear of personal injury rather than actual damage to property, education must seek to replace unwarranted fear with a more appropriate understanding of bear behaviour. Emphasis should be placed on convincing people to attempt to deter instead of kill nuisance animals, thereby reinstilling in bears a greater fear of humans. McCullough (1982:32) suggested that long-term coexistence between bears and people in parks requires "a relationship based upon fear and respect in both bear and human populations". This philosophy seems applicable as well in bear habitat outside parks.

LITERATURE CITED

ALT, G. L. 1980. Relocating nuisance bears. Pa. Game News 51(3):20-22.

BAKER, D.G., and J. H. STRUB, JR. 1963. Climate of Minnesota. Part II. The agricultural and minimum-temperature-free seasons. Univ. Minn. Agric. Exp. Stn. Tech. Bull. 245. 32 pp.

____, D. A. HAINES, and J. H. STRUB, JR. 1967. Climate of Minnesota. Part V. Precipitation facts, normals, and extremes. Univ. Minn. Agric. Exp. Stn. Tech. Bull. 254. 44 pp.

DAVENPORT, L. B. 1953. Agricultural depredation by the black bear in Virginia. J. Wildl. Manage. 17:331-340.

ERICKSON, A. W., J. NELLOR, and G. A. PETRIDES. 1964. The black bear in Michigan. Mich. State Univ. Agric. Exp. Stn. Res. Bull. 4. 102 pp.

FIES, M. L., D. D. MARTIN, and G. T. BLANK, JR. 1987. Movements and rates of return of translocated black bears in Virginia. Int. Conf. Bear Res. and Manage. 7:369-372.

FREE, S. L., and E. MCCAFFREY. 1972. Reproductive synchrony in the female black bear. Int. Conf. Bear Res. and Manage. 2:199-206.

GARSHELIS, D. L. 1986. Minnesota status report. Proc. East. Black Bear Workshop Res. and Manage. 8:30-37.

_____, K. V. NOYCE, and P. C. COY. 1988. Ecology and population dynamics of black bears in north-central Minnesota. Pages 43-53 *in* B. Joselyn, ed. Summaries of wildlife research project findings, 1987. Minn. Dept. Nat. Resour., Wildl. Populations and Res. Unit Rep.

GUNSON, J. R. 1979. Alberta status report. Proc. West. Black Bear Workshop 1:25-32.

HORSTMAN, L. P., and J. R. GUNSON. 1982. Black bear predation on livestock in Alberta. Wildl. Soc. Bull. 10:34-39.

JORGENSEN, C.J., R. H. CONLEY, R. J. HAMILTON, and O T. SANDERS. 1978. Management of black bear depredation problems. Proc. East. Black Bear Workshop 4:297-321.

KINSEY, C. 1965. The black bear in Minnesota. Pages 179-210 *in* J. B. Moyle, ed. Big game in Minnesota. Minn. Dept. Cons. Tech. Bull. 9.

KUEHNAST, E. L., D. G. BAKER, and J. A. ZANDLO. 1982. Climate of Minnesota. Part XIII. Duration and depth of snow cover. Univ. Minn. Agric. Exp. Stn. Tech. Bull. 333. 24 pp.

LORD, W. G., and J. T. AMBROSE. 1981. Black bear depredation of beehives in North Carolina, 1977-1979. Am. Bee J. 121:421-423.

MAEHR, D. S., and J. R. BRADY. 1982. Florida black bear - beekeeper conflict: 1981 beekeeper survey. Am. Bee J. 122:372-375.

MASSOPUST, J. L., and R. K. ANDERSON. 1984. Homing tendencies of translocated nuisance black bears in northern Wisconsin. Proc. East. Workshop Black Bear Res. and Manage. 7:66-73.

McARTHUR, K. L. 1981. Factors contributing to effectiveness of black bear transplants. J. Wildl. Manage. 45:102-110.

MCCULLOUGH, D. R. 1982. Behavior, bears, and humans. Wildl. Soc. Bull. 10:27-33.

MECH, L. D., L. D. FRENZEL JR., and P. D. KARNS. 1971. The effect of snow conditions on the vulnerability of white-tailed deer to wolf predation. Pages 51-59 *in* L. D. Mech and L. D. Frenzel Jr., eds. Ecological studies of the timber wolf in northeastern Minnesota. North Central Forest Exper. Stn. Res. Pap. No. 52.

MORSE, M. A. 1946. Big game division report. Minn. Wildl. Res. Q. 6(3):25-26.

NELSON, M. E., and L. D. MECH. 1986. Relationship between snow depth and gray wolf predation on white-tailed deer. J. Wildl. Manage. 50:471-474.

PELCHAT, B. O. 1982. Alberta status report. Proc. West. Black Bear Workshop 2:4-11.

PETRABORG, W. H. 1953. General observations on numbers, distribution, size, weight, and predation by bears. Minn. Wildl. Res. Q. 13:113-114.

_____. 1954. General observations on numbers, distribution, size, weight, and predation by bears. Minn. Wildl. Res. Q. 14:101-102.

_____, M. H. STENLUND, and V. E. GUNVALSON. 1949. General observations on numbers distribution, size, weight, and predation, by bears. Minn. Wildl. Res. Q. 9:142-143, 169-172.

PIEKIELEK, W., and T. S. BURTON. 1975. A black bear population study in northern California. Calif. Fish and Game 61:4-25.

PIMLOTT, D. H., J. A. SHANNON, and G. B. KOLENOSKY. 1969. The ecology of the timber wolf in Algonquin Provincial Park. Ontario Dept. Lands and Forests Res. Rep. (Wildlife) No. 87. 92 pp.

POELKER, R. J., and L. D. PARSONS. 1980. Black bear hunting to reduce forest damage. Int. Conf. Bear Res. and Manage. 4:191-193.

ROGERS, L. L. 1976. Effects of mast and berry crop failures on survival, growth, and reproductive success of black bears. Trans. N. Am. Wildl. Nat. Res. Conf. 41:431-438.

_____. 1986. Effects of translocation distance on frequency of return by adult black bears. Wildl. Soc. Bull 14:76-80.

_____. 1987. Effects of food supply and kinship on social behavior, movements, and population growth of black bears in northeastern Minnesota. Wildl. Monogr. 97. 72 pp.

_____, D. W. KUEHN, A. W. ERICKSON, E. M. HARGER, L. J. VERME, and J. J. OZOGA. 1976. Characteristics and management of black bears that feed in garbage dumps, campgrounds or residential areas. Int. Conf. Bear Res. and Manage. 3:169-175.

SCHORGER, A. W. 1946. Influx of bears into St. Louis County, Minnesota. J. Mammal. 27:177.

_____. 1949. The black bear in early Wisconsin. Trans. Wis. Acad. Sci., Arts and Letters 39:151-194.

SPENCER, H. E., JR. 1955. The black bear and its status in Maine. Maine Dept. Inland Fisheries and Game, Game Div. Bull. 4. 55 pp.

CONSIDERATION OF BEAR-PEOPLE CONFLICTS IN BLACK BEAR MANAGEMENT FOR THE CATSKILL REGION OF NEW YORK: APPLICATION OF A COMPREHENSIVE MANAGEMENT MODEL[1]

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Abstract: Bear-people conflicts were identified and considered in the management of the black bear (*Ursus americanus*) population inhabiting the northern Catskill region of southeastern New York state. Landowner acceptance capacity for bears was identified as the limiting factor for increasing the region's bear population to near range carrying capacity, a goal for bear management in the region. Thus, understanding and integrating the human dimensions with the biological dimensions of bear management were essential. Landowners were surveyed prior to and after a controlled increase in the bear population to determine changes in their beliefs about, attitudes toward, and experiences with bears, and whether their acceptance capacity for bears had been reached. Both actual and perceived conflicts (i.e., human perceptions of bears) influenced landowners' acceptance of bears. Generally, the more landowners knew about bears and had contact with bears, the more likely they were to accept more bears in the region. Nuisance and damage problems were uncommon and seldom led to a lower acceptance of bears among landowners who reported such problems. Lower acceptance capacities for bears tended to be associated with landowners' perceptions of the potential for bear-people conflict, rather than their actual experience of problems. The human dimensions and biological dimensions of bear management were integrated by applying a comprehensive, cyclical, and incremental management approach to the situation. This paper focuses on the management approach and the use of information on human dimensions in bear management.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Bear-people conflicts take a variety of forms. Often biologists responsible for managing bear populations, or park superintendents responsible for managing people in bear habitat are concerned with identified, specific sites (e.g., campgrounds, apiaries, dumps) where conflicts are likely to occur, and with animals that frequent such sites. In these situations the goal is avoidance of conflicts, particularly those involving threats to personal safety or economic loss.

Where wildlife biologists are responsible for bear population management across an extensive area co-inhabited by bears and people, many potential (and unidentified specifically) bear-people conflict situations must be considered. In addition to actual conflicts, these biologists must deal with an added dimension: people's perceptions of bears. These perceptions may not always be accurate. Nevertheless, people's fundamental beliefs and attitudes about bears, and the nature and extent of interaction they believe they will have with bears, become significant factors to be considered in the process of managing bear populations.

Wildlife biologists with the New York State Department of Environmental Conservation (DEC) have dealt with such a situation in managing the black bear population in the northern Catskill region of southeastern New York state. They have managed the bear population following an approach where public response (e.g., experiences with bears and attitudes about bears) to management results (i.e., the change in bear population) is monitored, evaluated, and used to adapt subsequent management actions. This is equivalent to the incremental, cyclical approach to management planning, implementation, and evaluation described by Krueger et al. (1986) (Figure 1). The approach is cyclical because each step depicted in the process model is attended to sequentially and regularly. It is incremental, rather than trial-and-error, because the process purposefully plans to monitor and use feedback to adjust the next management cycle.

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[1] A contribution of New York Federal Aid in Fish and Wildlife Restoration Projects W-39-R and W-146-R.

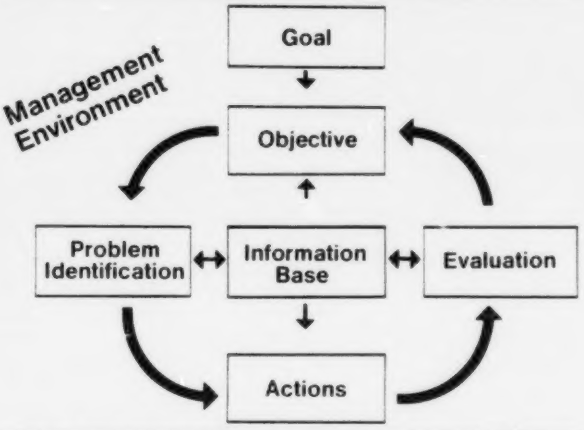

Figure 1. The Management Process (after Krueger et al. 1986).

AN OMNIBUS CONCEPT OF NATURAL RESOURCE MANAGEMENT

The general concept of natural resource management recently proposed by Krueger et al. (1986) was used to describe bear population management in the northern Catskills. Krueger et al. depict management as a dynamic, goal-oriented process that functions within a management environment having cultural, economic, political, and ecological components. The management process is described in terms of 6 interactive elements that operate within the management environment (Figure 1). *Goals* are broad statements of intent about the purpose of management. *Objectives* provide a measurable definition of the goal that is expected within a particular time frame; they operationally define the goals. *Problem identification* determines the impediments to achievement of objectives. *Actions* are implemented to solve, avoid, or lessen the effects of the problems. *Evaluation* measures the response of the management environment to the actions implemented in terms of the parameters in the objectives (in essence they become the criteria against which success is measured), and provides intelligence for fine-tuning or redirecting the management process. This latter step is essential if goals and objectives are to be revised, new problems identified, and alternate actions implemented that better address the current situation. Evaluation is integral to the feedback link that allows management to be an adaptive process. These 5 elements are supported by and contribute to the *information base* which includes published and unpublished data, collective experience, and theory from biology, sociology, psychology, ecology, political science, economics, administrative science, communications science, humanities, and other disciplines.

The discussion of the management environment by Krueger et al. (1986) is apropos to our more specific topic of bear management, and will be repeated here in part (Krueger et al. 1986:51):

> The management environment can be described as a composite of cultural, economic, political, and ecological components within which resource agencies must function. The cultural component includes the traditions, religions, and philosophies of the general public and resource managers. This component contributes most to the establishment of values by society for natural resources. These values provide the principal motivation for resource management. Management is conducted because the end products of the process are believed to have value to part or all of society.
>
> The economic component includes all the processes of the marketplace that can influence decisions about resource management. . . . The economic impact that results from management contributes to the societal perception of the value of management, and thus helps to define societal values.
>
> The political component may be divided into two aspects: first, the laws of government, and second the personal values of the individuals who enact, enforce, or interpret laws and policies. The first aspect can be clearly defined by the legislative statutes and administrative codes that give agencies the responsibilities for management. The second aspect is poorly defined because the biases of government officials are dynamic and undocumented.
>
> The ecological component includes the ecosystem where populations of interest live, grow, reproduce, and die. Management programs that intentionally focus on a particular species will often also alter the abiotic and other biotic parts of the ecosystem. The ecological component defines the upper boundaries of what management can expect to achieve in terms of resource production rates. . . .

Natural resource managers must consider simultaneously the cultural, economic, political, and ecological components of the management environment because they interact constantly. Historically, wildlife agencies have focused most attention on the ecological components; more recently, however, the other elements have been given greater attention. In many cases, wildlife management has been driven principally by the human dimensions rather than the ecology of the system being managed.

In this paper we will review the background, methods, and results of studies pertinent to bear management in the northern Catskill region of New York. Detailed reports of these studies can be found in Decker et al. (1981, 1985), McCaffrey et al. (1976), and O'Pezio and Clarke (1976). We will concentrate our discussion on the experience of applying a comprehensive management approach such as Krueger et al. (1986) espouse, which integrates the biological dimensions and human dimensions of management, to deal with bear-people conflicts in regional bear population management.

BACKGROUND

Black bears have long been a significant part of the wildlife community in the northern Catskill region of New York State. The northern Catskill bear range (Figure 2) is an area of some 2,500 km^2 (McCaffrey et al. 1976), characterized largely by the Catskill Mountain Landform (Stout 1958). The publicly-owned Catskill Forest Preserve provides most of the continuous forest habitat for bears.

During the 1950's and 1960's, the bear population in the northern Catskill range had been reduced markedly through the combined effects of habitat destruction and hunting. The declining population was indicated in records of dwindling annual harvests during the fall hunting season (Figure 3). During the early 1970's, DEC amassed considerable research data on bear biology and ecology in the region (McCaffrey et al. 1976), especially on natality, mortality, age structure, physical condition, movement and habitat use, denning behaviour, and recruitment by immigration. Of particular importance was the finding that hunting accounted for 90% of bear mortality in the region.

Information on the ecology of bears and habitat conditions in the northern Catskills enabled biologists to model and predict the dynamics of future bear populations under various management scenarios. In particular, managers believed that through careful management of hunting mortality a several-fold-larger bear population could be sustained given conditions of the habitat. Managers speculated that the "limiting factor" in achieving the biological potential would be people's tolerance of a larger bear population, or their "acceptance capacity" (Decker and Purdy 1988) for bears. The highest population level that would be tolerable was unknown, but was hypothesized to be above the level of the early 1970's and below actual carrying capacity of the range. Since 1970, data have been collected concerning property damage and other reported conflicts between bears and people, as well as indices of public attitudes toward bears. Generally, during 1970-1975, when a low but stable population of about 125 bears inhabited the region, hunting-related values of bears were high and reported conflicts with people were few (NYSDEC, unpubl. data).

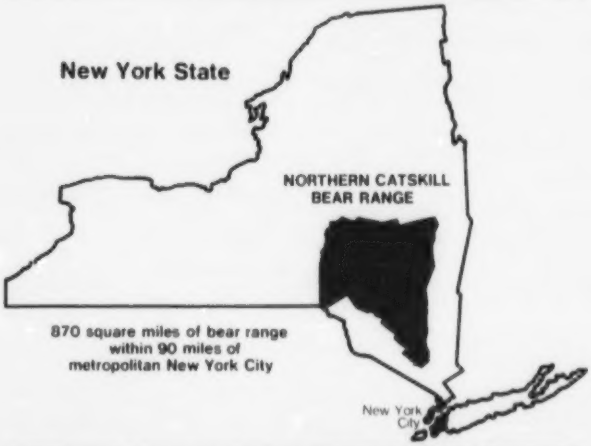
New York State
NORTHERN CATSKILL BEAR RANGE
870 square miles of bear range within 90 miles of metropolitan New York City
New York City

Figure 2. Northern Catskill Black Bear Range, New York State.

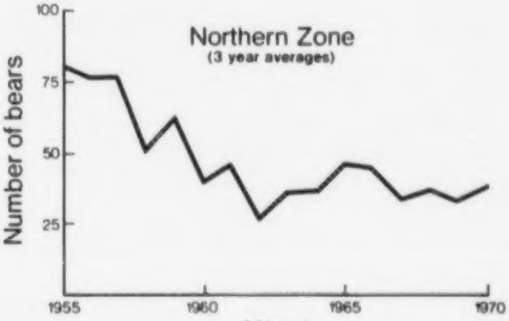

Figure 3. Black Bear Harvest Trends in the Catskill Region of New York State.

In 1976, the DEC initiated a management program to increase the bear population (O'Pezio and Clarke 1976). The strategy was to regain population levels comparable to those of the early 1960's (~250 bears), then attempt incremental growth, with periods of population stabilization and evaluation planned between the incremental increases. Public acceptance of each progressively larger bear population could then be assessed. This strategy would allow the DEC to determine the bear population level that approached the target acceptance capacity of landowners in the region (e.g., a specified percentage of landowners who experienced problems or who wanted the population to decrease).

To achieve the first population increase, bear hunting in the Catskill region was not permitted during 1976 and 1977. The bear population responded by increasing about 80% (from about 125 to 225) in the northern Catskill range (Clarke and O'Pezio 1978). Thereafter, recreational hunting was reinstituted with restrictions on season opening dates (i.e., later) and length of season (about 1 week). Bear populations were stable for 5 years (Figure 4) during which the biological and sociological acceptabilities of the higher bear population were evaluated. The actual number of bears was larger in 1977 than 1976 because no hunting mortality occurred. However, as a result of both reproductive synchrony and bear behaviour (i.e., cubs accompanying sows as family units) 1978 was the year when a larger bear population would be expected to be perceived by landowners of the region. Baseline data relating to the physical conditions of bears, bear-people conflicts, and public attitudes about bears were collected prior to the population increase of 1978 and served as the standard against which information collected afterward was compared. The methods and results reported herein will focus on how the evaluation of actual and perceived bear-people conflicts can be used in a comprehensive approach to bear population management.

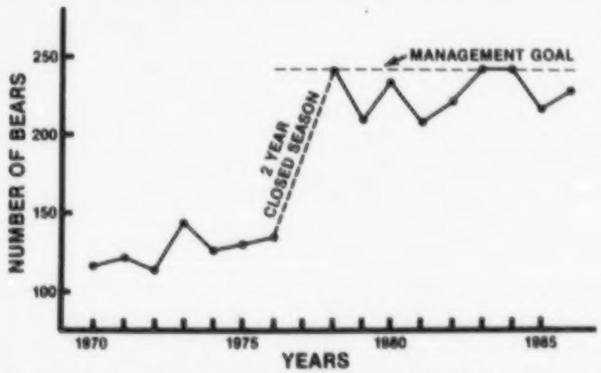

Figure 4. Black Bear Population Estimates in the Northern Catskill Range, New York State.

SURVEY METHODS

Baseline data, representing public inputs before the full bear population increase cited above could be perceived by landowners in the northern Catskill bear range, were obtained via a mail-questionnaire survey of 2,161 landowners undertaken early in the spring of 1978 (Decker et al. 1981). Following the initial mailing of a questionnaire and cover letter, up to 3 follow-ups were sent to nonrespondents. Data from 1,549 responding landowners (72% return) provided the first comprehensive input on the nature and extent of bear-people conflicts in the region. The questionnaire obtained information on landowners' knowledge of bears, sightings and tolerance of bears, nuisance or damage experience caused by bears, attitudes about bears, and preferences for population trends in the region. In developing the initial survey instrument, little information was available regarding public beliefs and attitudes about bears. Previous studies (Stokes 1970; Burghardt et al. 1972; Bacon 1974; Cole 1974, 1976; Rowell 1976; Baptiste 1977; Baptiste et al. 1979) had concentrated on visitors' attitudes about bears in various national parks and bear management at specific locations, rather than on attitudes and experiences of people owning land or living in a large geographic region inhabited by bears.

A second mail-questionnaire survey was conducted in 1983, following a 5-year period during which the bear population was maintained at a significantly higher level than had existed during the period from the late 1960's through 1977. Again, landowners were contacted, including a subsample of respondents to the 1978 survey, using a 4-wave mail procedure where up to 3 follow-ups were sent to nonrespondents. Data from the resurvey in 1983 (67% response rate; 673 usable returns) were used to detect changes in bear-people conflicts and public tolerance of bears resulting from the population increase. In addition, the survey sought to determine the nature of informational and attitudinal barriers to public acceptance of another incremental bear population increase.

KEY FINDINGS OF LANDOWNER SURVEY

Incidents of damage and nuisance situations were reported by 1% of respondents prior to the population increase, but rose to 5% following the population increase. Landowners generally were willing to accept occasional annoyances, and many would tolerate some degree of economic loss, as a reasonable personal cost of sustaining a larger bear population in the Catskills. Moreover, respondents in both surveys believed that an increase in the Catskill bear population would probably lead to an increase in bear-people interactions (both positive and negative). Despite their collective nuisance experiences and expectations, landowners more strongly supported additional efforts to increase the Catskill bear population in 1983 than in 1978 (74% versus 62%).

Considerable evidence suggested that misinformation or lack of information about bears may contribute substantially to apprehension among landowners about potential bear-people conflicts, in the absence of actual experience. For example, about 90% of landowners knew that black bears were present in the Catskills, but fewer (~75%) knew that only black bears lived in the area; others thought that brown bears and/or grizzly bears also inhabited the region. The survey revealed that misinformation about the species of bears living in the Catskills was more common among landowners who did not want the bear population to increase than among those who wanted an increase (52% versus 18%). Furthermore, only about 1/3 of those who did not want an increase in the bear population, versus 2/3 of those who wanted an increase, believed that bears were timid, stayed away from or only occasionally approached residences, and seldom caused damage, which was a fairly accurate description of the black bear situation in the Catskills.

Overall, personal experience with bears, including conflict situations, and knowledge of bears tended to decrease perceived conflicts and to increase acceptance of bears. That is, people were less likely to be concerned about potential conflicts, and were more tolerant of problems they actually experienced, if they had personal contact with bears or accurate knowledge of bear behaviour.

THE CYCLIC, INCREMENTAL MANAGEMENT APPROACH

The cyclic and incremental characteristics of the approach used in bear management in the northern Catskills is illustrated in Figure 5. After the decline in bear harvest persisted to the point where it was identified as a problem, DEC decided to undertake research (discussed earlier) to learn more about the biology and ecology of black bears in the northern Catskills. The status quo was maintained regarding the hunting season. Based on the research and records of bear nuisance and damage reports, a new population management objective was established. The process thereby exited the first major cycle and entered the second cycle.

In the second cycle, the importance of hunting mortality was recognized and dealt with through a 2-year moratorium on hunting to allow the first increment of population increase to the level specified in the objective. A baseline study of landowners found that their acceptance capacity for bears had not been reached with the depressed population that had existed for several years. Monitoring of biological parameters demonstrated that the physical condition of bears was very good at the higher population level achieved by the end of the cycle.

The objective for cycle 3 was to maintain the bear population at the higher level achieved during cycle 2. The problem identified for this cycle was whether landowners' acceptance capacity would be reached after 5 years of experience with the higher population level. Through special hunting regulations that minimized mortality of sows, the population was stabilized at the level reached by the efforts in cycle 2. At the end of cycle 3, a survey of landowners was conducted to determine whether acceptance capacity had been reached with the higher bear population. The survey indicated that more bears could be accepted in the region. This, together with data indicating that the biological condition of bears was still very good, suggests that a fourth cycle could be initiated to allow another incremental increase in bears in the region.

CONCLUSIONS AND IMPLICATIONS

The potential exists for reducing apprehension about bear-people conflicts and increasing public tolerance of actual damage and nuisance problems in the northern Catskill range. The DEC, by taking a comprehensive approach to black bear management in the region, has developed a better understanding of the human dimensions of the situation. Misperceptions by landowners have been identified and educational efforts to overcome these have been initiated. Furthermore, the iterative management approach being implemented for Catskill bear management allows the DEC to proceed in an adaptive-responsive manner, analogous to that described by Krueger et al. (1986). The DEC anticipates progressing with the basic sequence of a period of controlled growth of the bear population followed by a period of population stabilization and

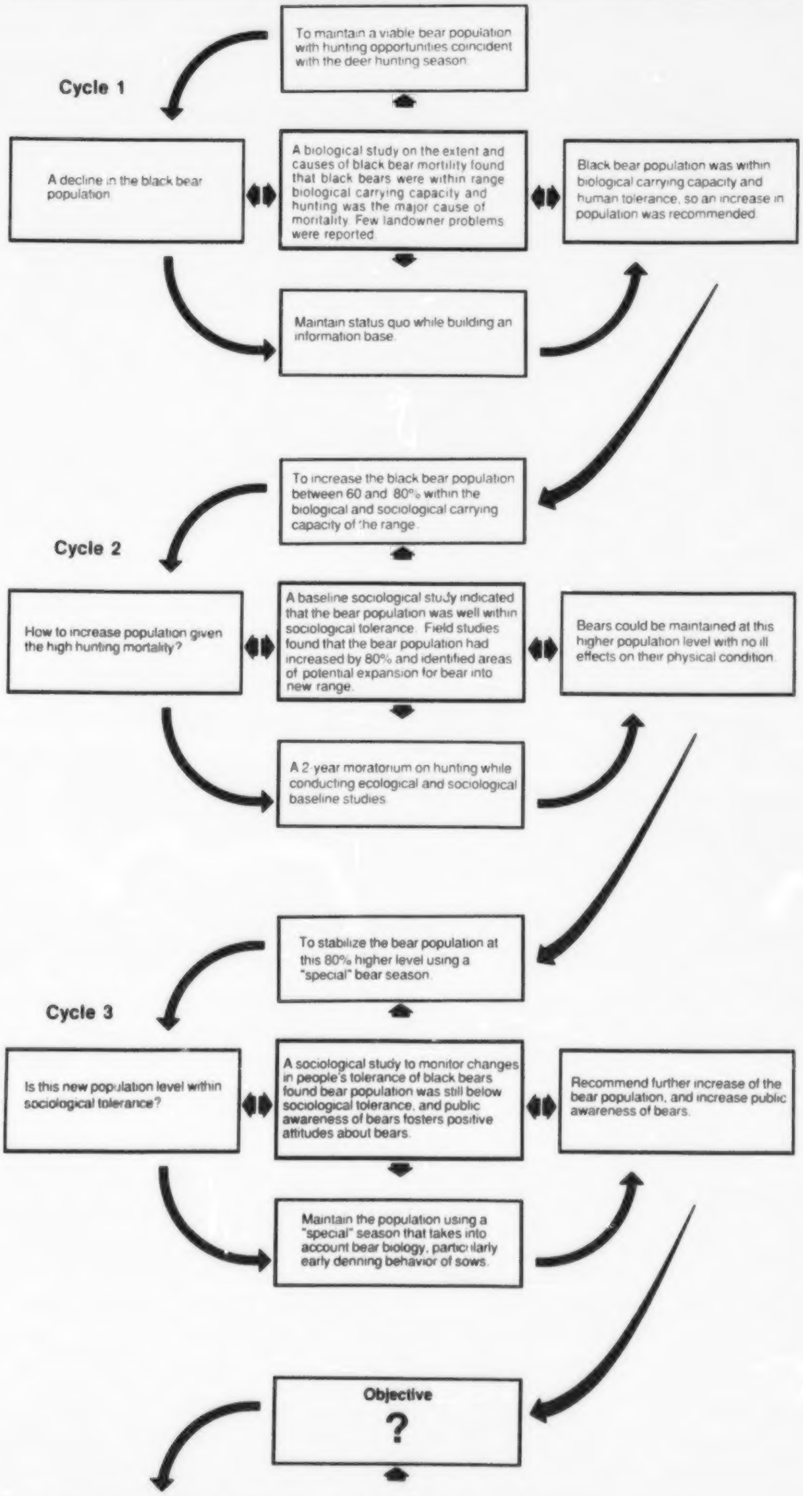
To maintain a viable bear population with hunting opportunities coincident with the deer hunting season
Cycle 1
A decline in the black bear population
A biological study on the extent and causes of black bear mortility found that black bears were within range biological carrying capacity and hunting was the major cause of mortality. Few landowner problems were reported.
Black bear population was within biological carrying capacity and human tolerance, so an increase in population was recommended.
Maintain status quo while building an information base.
To increase the black bear population between 60 and 80% within the biological and sociological carrying capacity of the range.
Cycle 2
How to increase population given the high hunting mortality?
A baseline sociological study indicated that the bear population was well within sociological tolerance. Field studies found that the bear population had increased by 80% and identified areas of potential expansion for bear into new range.
Bears could be maintained at this higher population level with no ill effects on their physical condition.
A 2-year moratorium on hunting while conducting ecological and sociological baseline studies.
To stabilize the bear population at this 80% higher level using a "special" bear season.
Cycle 3
Is this new population level within sociological tolerance?
A sociological study to monitor changes in people's tolerance of black bears found bear population was still below sociological tolerance, and public awareness of bears fosters positive attitudes about bears.
Recommend further increase of the bear population, and increase public awareness of bears.
Maintain the population using a "special" season that takes into account bear biology, particularly early denning behavior of sows.
Objective
?

Figure 5. Cycles in Black Bear Management for Northern Catskill Range, New York State.

evaluation of both biological and human factors, until either range carrying capacity or people's acceptance capacity is reached. The latter will be reflected in some maximum level of bear-people conflicts tolerable in the region.

LITERATURE CITED

BACON, E. S. 1974. Use of a survey of park visitor attitudes and knowledge to help formulate education programs. Pages 207-213 *in* M. R. Pelton and R. H. Conley, eds. Eastern workshop on black bear management and research, Great Smoky Mountains National Park. Tenn. Wildl. Resour. Agency, Nashville.

BAPTISTE, M. E. 1977. A survey of visitor knowledge, attitude, and judgment concerning black bears at Shenandoah National Park. M.S. Thesis, Virginia Polytechnic Inst. and State Univ., Blacksburg. 90 pp.

_____, J. B. WHELAN, and R. B. FRARY. 1979. Visitor perception of black bear problems at Shenandoah National Park. Wildl. Soc. Bull. 7:25-29.

BURGHARDT, G. M., R. O. HIETALA, and M. R. PELTON. 1972. Knowledge and attitudes concerning black bears by users of the Great Smoky Mountains National Park. Int. Conf. Bear Res. and Manage. 2:255-273.

CLARKE, S. H., and J. O'PEZIO. 1978. Recommendations for bear hunting seasons: 1978. N.Y. State Dept. Environ. Conserv. Fed. Aid Proj. W-89-R-22. Job X-6. 5 pp.

COLE, G. F. 1974. Management involving grizzly bears and humans in Yellowstone National Park, 1970-1973. BioScience 24:335-338.

_____. 1976. Management involving grizzly and black bears in Yellowstone National Park, 1970-1975. U.S. Dept. Inter. Natl. Park Serv. Natural Res. Rep. 9.

DECKER, D. J., T. L. BROWN, D. L. HUSTIN, S. H. CLARKE, and J. O'PEZIO. 1981. Public attitudes toward bears. N.Y. Fish and Game J. 28:1-20.

_____, and K. G. PURDY. 1988. Toward a concept of wildlife acceptance capacity in wildlife management. Wildl. Soc. Bull. 16(1):53-57.

_____, R. A. SMOLKA, JR., J. O'PEZIO, and T. L. BROWN. 1985. Social determinants of black bear management for the northern Catskill Mountains. Pages 239-247 *in* S. L. Beasom and S. R. Roberson, eds. Game harvest management. Caesar Kleberg Wildl. Res. Inst., Kingsville, Texas.

KRUEGER, C. C., D. J. DECKER, and T. A. GAVIN. 1986. A concept of natural resource management: an application to unicorns. Trans. Northeast Sect. Wildl. Soc. 43:50-56.

McCAFFREY, E. R., G. B. WILL, and A. S. BERGSTROM. 1976. Preliminary management implications for black bears, *Ursus americanus*, in the Catskill region of New York State as a result of an ecological study. Int. Conf. Bear Res. and Manage. 3:235-245

O'PEZIO, J., and S. H. CLARKE. 1976. Recommendations for the Catskill bear hunting season: 1976-78. N.Y. State Dept. Environ. Conserv. Fed. Aid Proj. W-89-R-20. Job X-6. 6 pp.

ROWELL, G. 1976. How Yosemite is solving the bear problem. Natl. Wildl. 14:24-28.

STOKES, A. W. 1970. An ethologist's view on managing grizzly bears. BioScience 20:1154-1157.

STOUT, N. J. 1958. Atlas of forestry in New York. N.Y. State Univ. Coll. For., Syracuse. Bull 41. 96 pp.

TOUR OPERATOR AVOIDANCE OF DETERRENT USE AND HARASSMENT OF POLAR BEARS

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Abstract: The effects of tourist activities on polar bears (*Ursus maritumus*) at Cape Churchill, Manitoba were evaluated. Thirty-two polar bears were observed from tourist vehicles between 3 and 26 October 1986. All bears had previous contact with humans; 23 on previous days and 9 the same day. Overall, an equal number of bears either approached the vehicle, moved away, or remained bedded; however, of the 9 bears that had human contact earlier the same day, 67% (6/9) moved toward the vehicle compared to 25% (6/23) for bears with previous days experience with tour vehicles. The majority of bears (19/30) under observation by tourists terminated the interaction, which suggests harassment may be a factor. Habitat-related responses of bears to tour vehicles were observed. Eight of 10 bears that showed no directional response to the vehicles were immatures. Bears visiting a temporary tourist camp behaved differently than bears seen from tour vehicles. Previous occupants of the camp had been actively feeding bears; therefore, the 2 situations were not compared, although personal observations are noted. An integration of data collection with tour operation is proposed as an immediate and long-term measure to foster the development of quality wildlife experience. The establishment of a standard tour guides' protocol is outlined.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

In the last 10 years a seasonal concentration of polar bears at Cape Churchill, Manitoba has been developed into a tourist attraction. Guided expeditions have the potential to provide some sustainable economic development to the area. However, sustainability is partly dependent upon a high standard of human safety and on minimizing the effects of human activities on the bears. Approximately 10,000 tourists come to the town of Churchill annually, with about 30% venturing beyond the townsite to observe the bears in their natural habitat. The probability of observing a polar bear is highest during the months of October and November. The most popular excursions are day trips in a "tundra" vehicle which travels beyond the road system. Other opportunities include overnighting at a temporary camp fashioned from several connected vehicles. In 1986, both of these activities were in the area of Gordon Point, approximately 30 km east of the Churchill River.

Some of the bears that are observed during tours eventually come to the Churchill townsite. Interactions that occur during the tours may determine future reactions of individual bears to humans in the community. This paper reports preliminary data from an observation/recording procedure investigating the effects of tours on polar bears.

We would like to thank Tundra Buggy Inc. for its cooperation in conducting the study. We would also like to thank B. Draper and A. Gould for their comments on the manuscript and Canadian Airlines for their support in providing transportation to the symposium.

STUDY AREA

The interior of Cape Churchill is one of the most concentrated polar bear denning areas in the world, producing about 150 cubs per year (Jonkel et al. 1972, Stirling et al. 1977). As in other populations, these polar bears are dependent upon the sea ice for the opportunity to hunt seals. However, there is a 3 - 4 month period when ice is not present on Hudson Bay and the bears are forced ashore.

Prior to freeze-up, there is a migration of bears to the north shore of Cape Churchill. In late October or early November, ice formation along the north coast of the cape usually permits the bears to return to their prime hunting habitat. Gordon Point is the main area of concentration used by tour operators to provide opportunities for viewing and photographing polar bears. The area is characterized by beach ridges, small lakes, and tidal flats. Some sections of the area are dominated by willows (*Salix* spp.) that reach a height of 2 - 3 m.

METHODS

The study was conducted in conjunction with regular activities of a tour operator 15 - 25 km east of the townsite of Churchill. The present work did not involve the experimental manipulation of bear-people encounters. In this initial study, recording of information on bear-people interactions was not continuous. Data collection was integrated with the responsibilities of one guide (P.S. Ratson). During the observation period there were 2 operators contracting as many as 7 guides in the area.

The tours used for systematic data collection were conducted according to the protocol of the aforementioned guide and coauthor. No baiting was permitted. The guide terminated the encounter if the bear appeared agitated by the presence of the tour vehicle. The bears were not allowed to touch the vehicle. Other activities in the area included groups of tourists who were more aggressive in their pursuit of opportunities for observation and photography. Some guides regularly permitted the bears to touch the vehicles, and members of other tours were observed hand-feeding bears. We were interested in characterizing situations which might cause harassment of bears or require the use of deterrents. An attempt by the bear to touch or approach the vehicle was considered to be potentially linked to deterrent use. Directional movement away from the tourist vehicle was interpreted as human-induced relocation. For each encounter, data were recorded on habitat, reaction distance, bear behaviour, length of encounter, and known previous contact of the bear with humans. Data were collected from a mobile vehicle between 3 and 25 October 1986. A second data sheet was developed for use at the temporary camp, also located at Gordon Point. Observations on the interaction between bears and the temporary camp were collected between 19 and 26 October.

The observations were taken from 2 types of vehicles. Daily excursions from the temporary camp were in a track-driven vehicle approximately 3 m long and 2 m high. The other mobile vehicles, including those used in construction of the camp, were raised off the tundra on large (1.5 m) tires, with observation windows 3 - 4 m above the ground. The large vehicles ranged in length from 8 - 10 m.

RESULTS AND DISCUSSION

Thirty-two bears were observed from the mobile units. About 2/3 of these animals tested the wind when they appeared to detect the vehicle. Further work should include the documentation of wind direction and speed so that the role of scent in determining the nature of the encounters can be clarified. The average time spent observing individual bears was about 20 minutes. None of the bears observed from the mobile units attempted to touch the vehicles or displayed any signs of aggression. The protocol of the individual guide may have been a factor affecting the behaviour of the bears. Further studies should include several bear monitors collecting data involving as many guides as possible.

Bears that had previous contact with a tour group the same day ($N=9$) approached the vehicle more often than bears that had not (Table 1). This would suggest that human exposure had an accumulative effect on some bears that results in more intensive interactions. Rate of approach was also high (58%) when the bear ($N=12$) appeared to detect the vehicle 150 - 250 m away (Table 2). A polar bear moving toward a group of people presents a potentially dangerous situation, even when the people are inside a vehicle. In 1983, a man was injured while inside one of the tourist vehicles. He had extended an arm through an open window not knowing that there was a bear close by.

All of the bears that approached ($N=9$) were walking; however, 4 of 10 bears that moved away from the vehicles were running (Table 3). These results suggest that human-induced relocation does occur, and should be considered when defining harassment. All of the animals that did not react to the vehicles ($N=10$) were bedded down when they first appeared to detect the vehicle.

Bears encountered along the bayshore ($N=9$) either moved towards or away from the tour vehicle (Table 4). Further habitat-related observations indicated that when bears are close to lakes and/or willows there is a low rate of directional response to the vehicles (Table 4). These habitats may be preferable for minimizing the interaction between the bears and the tourists. Further studies should differentiate between willows along the coastline and those inland.

Eight of 10 bears (80%) that did not have a directional response to the vehicle were immatures (Table 5). We found that the highest rate of bears approaching the vehicles (45%) occurred between 16 and 20 October.

The temporary camp had been set up for several weeks prior to our data collection. Tourists staying in the camp before we started working there were observed hand-feeding the bears. Sardines and/or lard had also been put in the willows surrounding the camp. The

Table 1. Response of polar bears to tourist vehicles at Cape Churchill, Manitoba in relation to previous known contact of bears with humans.

Known Contact with Humans								
Previous Day			Not Same Day			Same Day		
Moved Away	Moved Toward	Moved Neither Toward nor Away	Moved Away	Moved Toward	Moved Neither Toward nor Away	Moved Away	Moved Toward	Moved Neither Toward nor Away
2	2	0	7	4	8	1	6	2

Table 2. Response of polar bears to tourist vehicles at Cape Churchill, Manitoba in relation to distance at which polar bears appeared to detect vehicles.

Distance at which vehicles first detected (m)											
<50			50-150			150-250			>250		
Moved Away	Moved Toward	Moved Neither Toward nor Away	Moved Away	Moved Toward	Moved Neither Toward nor Away	Moved Away	Moved Toward	Moved Neither Toward nor Away	Moved Away	Moved Toward	Moved Neither Toward nor Away
1	0	2	1	0	3	3	7	2	5	3	3

Table 3. Response of polar bears after detecting a tourist vehicle, Cape Churchill, Manitoba.

Behaviour	Moved Away	Moved Toward	Neither	Total
Ran	4	0	-	4
Walked[a]	6	9	0	15
Remained Bedded	-	-	10	10
Total	10	9	10	29

[a] Some bears walked for a distance and then lay down.

Table 4. Habitat - specific responses of polar bears after detecting a tourist vehicle, Cape Churchill, Manitoba.

Willows (N=21)			Open Tundra (N=2)			Bayshore (N=9)			Lakes (N=15)		
Moved Away	Moved Toward	Moved Neither Toward nor Away	Moved Away	Moved Toward	Moved Neither Toward nor Away	Moved Away	Moved Toward	Moved Neither Toward nor Away	Moved Away	Moved Toward	Moved Neither Toward nor Away
7	6	8	0	1	1	5	4	0	4	4	7

Table 5. Age- and sex-specific movements of polar bears relative to a tourist vehicle, Cape Churchill, Manitoba.

Sex	Moved Away	Moved Toward	Neither	Total
Adult male	2	1	1	4
Adult female	1[a]	2	0	3
Adult, sex unknown	3	3	0	6
Adult total	6	6	1	13
Immature male	1	3	2	6
Immature female	0	0	2	2
Immature, sex unknown	2	0	4	6
Immature total	3	3	8	14
Male, age unknown	0	0	0	0
Female, age unknown	0	1	0	1
Male total	3	4	3	10
Female total	1	3	2	6
Total sex unknown	5	3	4	12
Age and sex unknown	2	1	1	4
Total animals	11	11	10	32

[a] With cub of the year.

behaviour of the camp bears was quite different when compared to the animals encountered from the mobile units. As a result, we were not able to use our data sheet outline, but general observations were recorded. During the 6 days we were in the camp, 9 bears approached; 6 of these appeared to be using the camp as a temporary ecocentre. At the sound of movement within the camp, one bear repeatedly charged the structures and pounded on the walls. In the 6 days, 7 charges were initiated by 2 bears. The charges appeared to be directed at the people in the camp.

While the previous group used the camp, a bear that they had fed almost entered the stationary vehicles. The bear was deterred with a broom and red cayenne pepper sprayed in the face. Four days later and 4 km southwest, a bear with a red stain on its forehead, which may have been the cayenne pepper spray, charged a group of 12 people. The bear ignored both "cracker shells" and shots from a .44 calibre handgun. The people involved were forced to either climb a nearby tower or enter an adjacent building.

In the present study, we were interested in comparing the data from mobile vehicles with the camp situation. However, the feeding of bears in the camp before our arrival made the comparison invalid. The interactions that occurred in the camp were similar to those reported by Herrero (1985) in cases where grizzly bears feed upon human garbage. In a recent film done prior to a ban on baiting, some of the footage was obtained by baiting bears to a cage with a photographer inside. Subsequently, a reenactment of this approach led to an attack on an unsuspecting group of local hunters and the death of a bear.

Baiting polar bears in the Cape Churchill area has been illegal since 1985. Non-compliance to existing regulations is also a management problem for human-bear relations in other areas. In Katmai National Park, Alaska, potential problems exist as a result of individuals disobeying the regulation against fishing within 45 m of a grizzly bear (*U. arctos*) (Braaten and Gilbert 1988). Compliance to existing regulations is central to the development of a management strategy for Churchill's growing polar bear-tourist industry. At present, there is a maximum fine of $50.00 for baiting polar bears. Gratuities to individual tour guides can be as high as $1,000.00 for several days work, and groups often request or demand pictures of the bears close to the vehicles. The tour guides that reject baiting may lose business to other guides or operators. Baiting of bears for photography and viewing opportunities continued during the fall of 1987.

CONCLUSIONS AND MANAGEMENT CONSIDERATIONS

Bears that are fed as a result of the issuance of provincial operating permits are the responsibility of the province. The province can and may be considered liable for property damage and/or human injuries resulting from these activities.

There is a need to develop a standard protocol for the tour guides to use when approaching bears. The development of a specific protocol should be done by biologists working with the tour guides and the operators. This approach has been quite successful at minimizing the problems associated with a similar tourism industry at McNeil River Falls in Alaska (Aumiller 1984). Prior to implementing the McNeil River program, there were indications that grizzly bears were being forced out of prime habitat. Human-induced relocations were also observed in the present study (Table 3). In the Churchill area, a standardized guide's protocol should be developed in conjunction with a training program. Protocol considerations should include minimum approach distances, limitations on the number of times a bear is approached (Table 1), and the minimizing of directional responses to the vehicles (Table 3).

Individual operators and guides should be required to demonstrate an understanding of the protocol before permits are issued. The responsibility for following the protocol should, in part, be with the tour operator. Operators that cannot control the activities of their guides or clients should have their permits revoked. The interaction between the tour groups and the bears should be independently monitored and include a close liaison between on-site monitors and Natural Resources Enforcement Officers. Enforcement officers should be given the authority to close areas, regulate habitat use, and revoke operating permits. Independent monitors should be considered an integral part of the development of this tourist industry. Monitoring bear behaviour would result in the clarification of age- and habitat-specific responses (Tables 4 and 5), as well as provide information on management problems that may develop as a result of the tourist activities. Further study is required to determine the viability of temporary camps in comparison to mobile vehicles.

The local tour operators and guides have a desire to establish and maintain Churchill as a "world class" tourist destination. National and international naturalists are aware that a quality wildlife experience is dependent upon minimizing the effects of human activities on the bears. Present practices may be detrimental to the animals and also increase the probability that Churchill residents will be injured by polar bears. It is the responsibility of both the province and the operators to provide a sound management strategy that allows the industry to develop within a predictable and monitored framework.

LITERATURE CITED

AUMILLER, L. 1984. Alaska's best bear show. Alaska Magazine. May:18-21.

BRAATEN, A. M., and B. K. GILBERT. 1988. Profile analysis of human-bear relationships in Katmai National Park and Reserve. National Park Service, Anchorage, Alaska. 89 pp.

JONKEL, C., G. B. KOLENOSKY, R. J. ROBERTSON, and R. R. RUSSELL. 1972. Further notes on polar bear denning habits. Int. Conf. Bear. Res. and Manage. 2:142-158.

HERRERO, S. 1985. Bear attacks: their causes and avoidance. Winchester Press, Piscataway, NJ. 287 pp.

STIRLING, I., C. JONKEL, P. SMITH, R. ROBERTSON, and D. CROSS. 1977. The ecology of the polar bears (*Ursus maritimus*) along the western coast of Hudson Bay. Can. Wildl. Serv. Occas. Pap. 33. 64 pp.

THE MANAGEMENT OF THE GRIZZLY BEAR ON PRIVATE LANDS: SOME PROBLEMS AND POSSIBLE SOLUTIONS

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Editor's Note: This paper was not presented at the Symposium, but was submitted and published because of its relevance to the subject of the Symposium. It received the same peer review as other papers.

Abstract: The grizzly bear (*Ursus arctos*) is a wide-ranging animal that is rarely tolerated in close proximity by humans. Much of the remaining low-elevation spring and fall habitat for this species is in private ownership in the grizzly's remaining range in the contiguous United States. The activities of humans in this habitat often involve the use or production of attractive food sources for bears such as livestock, fruit trees, bee yards, and garbage. The result is bear-human conflict, usually resulting in the death of bears. The majority of bear-human conflicts in recent years have been on these private lands. Major private land areas in grizzly range include the towns of Gardiner, West Yellowstone, and Cooke City, the Rocky Mountain Front, the west slope of the Mission Mountains, and the Bull River valley. Solutions to minimize conflicts range from acquisition of such lands to local ordinances and increased public education. The response of local landowners is the determining factor in the success of management efforts, due to the limited statutory authority of state and federal agencies on private lands. The success of the overall grizzly bear recovery effort must include increased efforts to manage bears on private lands, as they have the potential to act as population sinks for the surrounding habitat that is in public ownership. Such continued population losses will negate the effectiveness of public land management for the grizzly bear.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

HISTORICAL PERSPECTIVE

The grizzly bear was once present throughout most of the western United States and south into central Mexico. In states such as California, the grizzly bear was common and occupied much of the habitat that is now prime agricultural land in the central valley and along the coast. With the arrival of white settlers in the American west, the range of the grizzly began to shrink. Most early settlers found the grizzly a dangerous competitor that was not to be tolerated. The belief that predators were bad and an impediment to successful settlement promoted the intensive eradication of the species.

Cattle and sheep were introduced in vast numbers throughout the American west and their use of habitat resulted in a dramatic change in the distribution and density of native vegetation, especially in riparian areas where vegetation was succulent year-round.

As David E. Brown (1985) points out in *The Grizzly in the Southwest*, the existence of the grizzly bear was impossible given the stocking levels that existed in the early 1900's. The livestock eliminated the bear foods. When bears began to prey on livestock because they had nothing else to eat, they were eliminated even more vigorously as human intolerance of bears increased. Stockmen viewed the grizzly as a real threat, and it was generally considered that commercial cattle and sheep production could not coexist with the grizzly bear. Livestock associations and individual operators hired predator control personnel to kill all grizzly bears and wolves in their areas of operation.

Grizzly populations rapidly declined and became limited to remote areas. As human populations increased, livestock, farming, and townsite development were concentrated in the low-elevation areas and along rivers and streams that were primary zones of use and travel for bears. As low-elevation areas became unsuitable due to the presence of humans, and as bear populations in these areas were destroyed, the remaining grizzly bears were isolated in insular populations concentrated at higher elevations and in less valuable habitat on lands mostly in public ownership.

In the contiguous United States, the grizzly bear was eliminated from 99% of its historic range by about 1940 (Storer and Tevis 1955). The main strongholds of the bear were lands in public ownership, but even there the grizzly was intensively persecuted in the early 1900's. During the period from 1910 to 1940, the grizzly population was probably at its lowest point (Merriam 1922, Storer and Tevis 1955, Brown 1985). This was precipitated by a strong predator control philosophy, the intensive use of private agricultural lands, and the widespread grazing of public lands by the livestock industry, especially by domestic sheep. Much of the area that is now considered wilderness in Idaho, Montana, and Wyoming was intensively overgrazed by livestock during this period.

Even national parks were subject to intensive predator control. It was only because the grizzly bear was not thought of as an important predator on wild ungulates that it was not actively persecuted in Glacier and Yellowstone (Murie 1940, Schullery 1980). These areas remained important strongholds and refugia for the grizzly bear during this time, although Keating's (1986) analysis indicated that the population in Glacier National Park in the 1900's-1920's was perhaps less than 1/3 of the present population. In an area like the Selway-Bitterroot, which had no national park to serve as a refuge for grizzly bears, the species was essentially eliminated through intensive predator control efforts. The damming of the Clearwater River in 1927, which eliminated the major steelhead and salmon runs, was probably the final chapter for the Selway-Bitterroot grizzly bear.

THE PRESENT SITUATION

With the decline of the domestic sheep industry, the designation of wilderness areas, and the concern with wildlife management that began in the 1930's, grizzly bear populations probably increased and began to reoccupy much of the public land surrounding the refuges provided by Glacier and Yellowstone National Parks. However, no hard data are available on bear numbers. More recently, with careful state management and the protection of the grizzly under the Endangered Species Act, grizzly numbers have increased in the core areas and bears have reoccupied many of the areas on the periphery of these ecosystems. These ecosystem edges are mostly private lands in places such as Yellowstone, the Northern Continental Divide, the Cabinet-Yaak, and the Selkirks. Many of these private lands contain seasonally important range as well as attractive food sources associated with humans such as garbage, domestic livestock, and human foods.

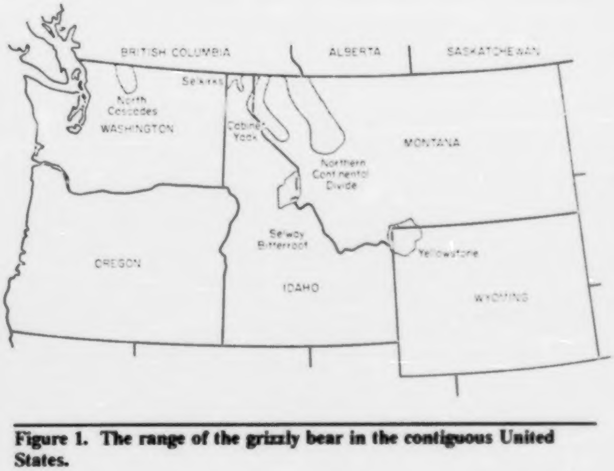

Figure 1. The range of the grizzly bear in the contiguous United States.

One of the major problems facing the conservation of the grizzly bear is the fact that its remaining range is separated into 6 isolated areas or ecosystems (U.S. Fish and Wildlife Service 1982) (Figure 1). These include the Yellowstone ecosystem, the Northern Continental Divide ecosystem, the Cabinet-Yaak ecosystem, the Selkirks ecosystem, the North Cascades ecosystem, and the Bitterroot ecosystem. Although the current range is not considered optimum for conservation of the species, there is little support to expand the range because of the prevailing public attitude of intolerance toward the grizzly bear. The grizzly may be unique among threatened and endangered species in the United States in that its range cannot be changed to enhance the probability for successful conservation and survival of the species.

Throughout the contiguous United States, 95% of occupied grizzly bear range is in federal and state ownership, or is owned by American Indian tribes as part of their reservations. The remaining 5% is in private ownership (U.S. Fish and Wildlife Service 1982) (Table 1).

The increase in human activity in grizzly bear range has resulted in increasing bear-human conflicts. Bears which come into contact with humans while seeking food are labelled "nuisance" or "problem" bears (Interagency Grizzly Bear Committee 1986). The majority of problem bear reports are from private lands, although the intensive use of national parks, national forests, and Indian reservations also results in bear-human conflicts.

Table 1. Grizzly bear ecosystems in the contiguous United States.

Ecosystem	Total Area[a]	Private Land[a]	Percentage of Total
Yellowstone	23,828	220	1.0
NCDE[b]	24,864	1,890	8.0
Cabinet-Yaak	5,180	233	5.0
Selkirk	2,800	114	4.0
North Cascades	-------undetermined--------		
Bitterroot	-------undetermined--------		

[a] Areas in sq. km.
[b] Northern Continental Divide Ecosystem.

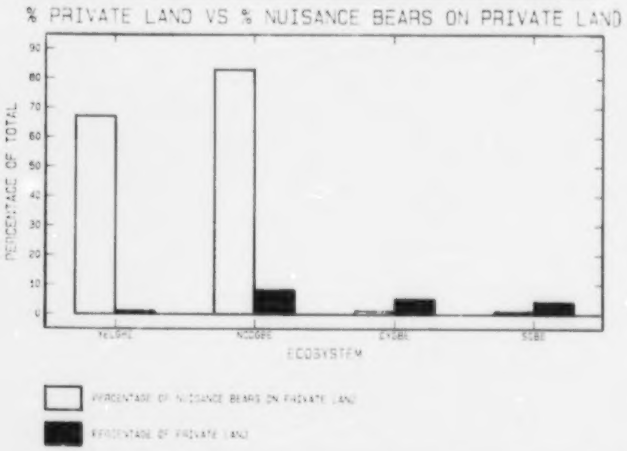

Figure 2. Percentage of privately owned grizzly habitat compared with percentage of nuisance bears reported on private land. YELGBE = Yellowstone; NCDGBE = Northern Continental Divide; CYGBE = Cabinet-Yaak; SGBE = Selkirks.

There is considerable disparity between the limited occurrence of private land in grizzly range and the high occurrence of problem bear complaints on these lands (Figure. 2). On public lands, efforts to reduce the availability of attractive food sources, such as human foods, have resulted in declining numbers of bear-human conflicts despite the fact that visitor use of public lands has increased (U.S. National Park Service 1987).

However, numbers of conflicts on private lands continue to be high and appear to be increasing. This suggests that management efforts have had limited success in controlling the levels of conflicts in these areas. In 1986, as an example, 22 (66%) of the 33 problem bears captured in the Yellowstone ecosystem initially were involved in conflicts on private lands (Table 2).

Table 2. Location of problem bear captures in the Yellowstone Ecosystem, 1986.

AREA	NUMBER	% OF TOTAL
Cooke City[a]	7	21
Gardiner[a]	7	21
West Yellowstone[a]	8	24
Bridger-Teton[b]	4	12
Gallatin[b]	1	3
Beaverhead[b]	1	3
Yellowstone[c]	5	16
TOTAL	33	

[a] Private lands not subject to federal management.

[b] National Forest.

[c] National Park.

Table 3. Location of problem bear captures in the Northern Continental Divide Ecosystem, 1986.

AREA	Number	% OF TOTAL
Rocky Mountain Front[a]	3	50
Mission West Slope[a]	1	17
West Glacier[b]	1	17
Glacier National Park	1	17
TOTAL	6	

[a] Private ranch land.

[b] Private townsite.

Six problem bears were captured in the Northern Continental Divide ecosystem in 1986, and 5 (84%) had their initial conflict on private land (Table 3). Considerably more bear-human conflicts occurred in the Northern Continental Divide ecosystem than are reflected by the small number of bears captured. Most of the problems occurred on the Rocky Mountain Front, a strip of ecotonal habitat between the mountains and the prairie that is mostly private land. In this area in 1986, grizzly bears on private land were involved in 7 incidents of beehive depredation, 5 depredations on cattle, 5 depredations on sheep, 5 conflicts related to human food, garbage, or carrion, and 5 people-bear encounters (M. Madel, Montana Dept. Fish, Wildlife, and Parks, pers. commun.). In contrast, in the 92% of this ecosystem in public ownership, there occurred only 1 problem bear complaint in 1986. It is likely that the bear populations are increasing in areas such as the Rocky Mountain Front, where long-time residents report bears in places where they have never seen bears before in their lifetime. This increasing population is probably due to the success of conservation efforts initiated since 1975, such as controlling grizzly mortality through hunting quotas, habitat protection, law enforcement, and public education. As populations increase, more animals are occupying private lands where conflict-causing attractants are more common.

Another possible reason for the increase in conflicts is increasing numbers of people in grizzly habitat. For example, on the west slope of the Mission Mountains, subdivision of private lands in bear habitat is resulting in increasing conflicts in this area of decreasing bear population.

REASONS FOR CONFLICTS

A major difference between human activities on public and private lands is the fact that people permanently reside on private land, whereas the closest things to permanent residence on public lands are activities such as outfitter camps or site developments in national parks. Site developments on private lands, especially townsites, have been the source of considerable numbers of bear-human conflicts.

In the Northern Continental Divide ecosystem, the majority of conflicts resulting in bear captures are related to farming and ranching activities and involve livestock depredations (Table 4). In 1986, 5 cattle and 10 domestic sheep were victims of grizzly depredations on the Rocky Mountain Front. In all of Montana in 1986, 23 domestic sheep were reported killed by grizzly bears. This compares to 14,600 sheep reported killed by coyotes in Montana in 1985 (Montana Crop and Livestock Reporting Service, pers. commun.). Of the 27 reported grizzly-human conflicts on private lands on the Rocky Mountain Front, 5 (18.5%) were directly related to bears eating garbage and in only 1 case was a bear captured in connection with garbage.

Overall, the losses of livestock to grizzly bears are minimal. There were no reported losses in Wyoming, Idaho, or Washington in 1986. At this time, losses of domestic livestock to grizzly bears appear to have a minimal impact on the economic viability of the industry, although the loss to individual operators could be significant in rare cases.

In the Yellowstone ecosystem, only 6% of the conflicts were due to livestock or farming or ranching operations (Table 4). In this ecosystem, all bear-human conflicts on private lands occurred in the 3 towns of Cooke City, Gardiner, and West Yellowstone. Bears were attracted to each of these towns for different reasons. In Gardiner, 7 bears were captured in association with domestic fruit trees. Apparently, the bears were venturing into town to feed on apples and other unharvested fruit on trees maintained for ornamental purposes. In West Yellowstone, 8 bears were captured in town feeding on unsecured garbage. It is possible that one or more people were feeding bears in the West Yellowstone area, thus conditioning these animals to human foods.

POSSIBLE SOLUTIONS

Local Support and Cooperation with Landowners

Local support is the key to proper management of private lands to minimize bear-human conflicts. Local attitudes often reflect the level of bear-human conflicts, and how these conflicts threaten the economic base of the area. For example, concerns about bears in West Yellowstone began to change after an adult female with cubs was removed from town in 1983. This bear had become food-conditioned and was a dangerous hazard in town. After repeatedly entering town, she was captured and separated from her young and shipped to a zoo. This incident resulted in a storm of local protest against management agencies, but it also provided a forum which allowed the local residents to realize the real reason for the removal of this bear - the availability of garbage throughout the town. Two other incidents have influenced public concern in West Yellowstone. In 1984, a person was killed by a garbage-conditioned grizzly bear close to town; and in 1985 there was an influx of tourists driving around town at night to see garbage-eating bears. The frequent interactions between bears and people in town were perceived as a safety hazard by the town leaders.

By contrast, in the towns of Gardiner and Cooke City, there has been no parallel evolution of local concern. In Cooke City, which is unincorporated, there is much disagreement about whether or not the bears should be fed. Some people believe the feeding of garbage to bears is essential to the survival of the species in the Yellowstone ecosystem. This perception, fostered by a few vocal individuals, and the fact that no one has yet been hurt by bears frequenting the town, are probably responsible for the lack of concern in this area. The

Table 4. Reasons for captures of problem grizzly bears in the Northern Continental Divide Ecosystem (NCDE) and Yellowstone Ecosystem, 1986.

	-------NCDE-------		---Yellowstone----	
Cause	Number	% of total	Number	% of Total
Domestic Livestock	1	20	2	6
Carrion[a]	2	40	7	21
Bee Hives	1	20	0	0
Garbage	1	20	17	52
Fruit Trees	0	0	7	21
Totals	5		33	

[a] Use of carrion in close proximity to human residences was often cause for capture of bears to avoid potential conflicts.

town consciousness in Gardiner seems to be intermediate between that of Cooke City and West Yellowstone. Grizzly bears occur infrequently in town and bears are not considered a major issue at this time.

Ordinances and Laws

Management agencies have limited authority to require the elimination of attractive food sources on private lands. Experience on public lands, such as Yellowstone and Glacier National Parks, has shown that enforcement of regulations requiring proper food storage and garbage disposal can contribute to a decrease in bear-human conflicts, even where the potential for such conflicts is high (Schullery 1980). There is no statutory authority under either state or federal law requiring securing of food on private land, and it is up to local or municipal ordinances or zoning to require the securing of garbage in relation to bears. Where such ordinances are lacking, voluntary cooperation is necessary if conflicts are to be minimized.

The town of West Yellowstone enacted an ordinance in 1986 requiring proper garbage disposal, and it has been enforced several times. All future developments in the West Yellowstone area will be required to assure the proper disposal of garbage and the holding of garbage in bear-proof facilities prior to disposal.

Cooperative Efforts

In another effort to deal with the garbage-bear situation in West Yellowstone, a cooperative effort was joined by the local community; Gallatin County; the State of Montana; Montana Department of Fish, Wildlife and Parks; the U.S. Forest Service; the National Audubon Society; the Burlington Northern Foundation; and Waste Management, Inc. These groups achieved a cooperative agreement to secure the funds to replace the more than 140 garbage containers in West Yellowstone with bear-proof dumpsters. A local ordinance will require the use of these dumpsters once all the old containers are replaced. This situation is a model for cooperative local, state, and national efforts to minimize the availability of garbage to bears.

Public Education

Public education can also play a role in reducing bear-human conflicts. Intensive campaigns by the Forest Service and the town of West Yellowstone have attempted to promote a sense of cooperation among local residents regarding bear-proofing the town. In Cooke City, however, public relation efforts have not been so successful. The town is unincorporated and thus has no leadership to focus the energy of the town on the bear problem. One person continues to defy the garbage control program by providing garbage for bears at his facility, and even has been known to advertise that bears can be seen in town.

New residents often move into grizzly bear habitat strictly for its aesthetic qualities. They rarely have the economic necessity to be involved in farming and ranching, but may come as "hobby farmers" keeping pigs, chickens, sheep, or bees to which bears are attracted. Many of these new residents are unfamiliar with bears and the precautions necessary to avoid conflicts with them. They express surprise and anger that bears might exist close to their new houses and are often the most vocal in demanding that bears be removed. The increase in numbers of people in bear habitat presents an ongoing public education problem, especially because the lack of ordinances requiring proper sanitation makes voluntary cooperation the only way conflicts will be minimized.

Land Acquisition

In some areas, small sections of private land exist in important grizzly bear habitat at low elevations. These areas are potentially important for the local grizzly population. Yet if they are subdivided and developed, they may be sites of continuing bear-human conflict and act as potential population sinks. Such small land-holdings exist in the Cabinet-Yaak and Northern Continental Divide ecosystems, primarily along rivers. Land acquisition to convert such areas to public ownership or conservation easements may be in the best interests of the grizzly bear. The identification and acquisition of such sites could promote the conservation of the species and should be a high priority.

Reimbursement Programs

Residents whose livelihood depends on ranching or honey production have limited tolerance for grizzly depredations which result in economic loss. A reimbursement program has been considered in Montana, and instituted in Alberta, to pay for livestock verified to be lost to grizzly bears. The Great Bear Foundation has recently instituted a limited program of this type in the Northern Continental Divide ecosystem in Montana, but there is no government-supported reimbursement in this area. Reimbursement programs have had varying degrees of success. In some cases, livestock owners may be willing to be reimbursed, yet they may still call for the elimination of the offending bear. Livestock associations in Montana have generally not been supportive of a reimbursement program while those in Alberta seem to accept this approach. Because grizzly bears are opportunistic, it is likely that some bears that become livestock killers will continue to frequent private lands and become habitual problem bears. The long-term economic impact of such behaviour could be significant to the reimbursing agency should the bear not be removed.

In Spain and France, where small populations of brown bears exist in remote but heavily grazed areas, the government supports a reimbursement program and pays stockmen for any livestock lost to bears. In this situation where the bear populations are endangered, the bears are not removed or relocated. The reimbursement program is aimed at preventing the illegal killing of bears by stockowners. The Spanish and French authorities consider their programs a success, but they work in countries where the brown bear populations are in the range of 20 - 100 animals.

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

The 5% of grizzly habitat which is private land presently experiences the majority of bear-human conflicts. Most conflicts result from unsecured attractive food sources such as garbage, carrion, human foods, and livestock. No state or federal laws require the securing of attractive food sources from bears on private lands, although some local communities such as West Yellowstone have initiated local ordinances. Without statutory limitations and enforcement, the elimination of bear-human conflicts on private lands depends on the cooperation of local residents. Public education, and perception of the costs and benefits of living in grizzly habitat, will determine the level of local cooperation. New residents in grizzly range are often least knowledgeable about bears, and may be less willing to cooperate to minimize conflicts.

The long-term survival of the grizzly bear may be affected by continuing bear-human conflicts on private lands. In places like the Yellowstone ecosystem, the 1% of the habitat in private ownership has the potential to act as a population sink if a high percentage of the population becomes conditioned to human foods. Without successful resolution of the private land problem in Yellowstone, it is likely that continuing successful management efforts on public lands will be negated. Similar problems may exist in other grizzly bear ecosystems as management results in increasing grizzly populations.

Experience indicates that the sensitivities of local residents, and their willingness to make sacrifices in order to maintain a minimum level of conflict, are related to their perception of bears and the economic costs of having bears around. Public education and how the grizzly bear recovery effort is viewed will play a key role in determining public perception. The existence of key grizzly habitat in private ownership necessitates a cooperative effort between landowners and public management agencies. In some cases, such as on the periphery of existing range, management agencies must act to limit the numbers of bears in order to minimize conflicts and convince landowners that they share their concerns. The long-term survival of the grizzly will depend on a successful balance between conservation of the species and the maintenance of landowner support.

LITERATURE CITED

BROWN, D.E. 1985. The grizzly bear in the southwest. Univ. Oklahoma Press, Norman. 274 pp.
INTERAGENCY GRIZZLY BEAR COMMITTEE. 1986. Interagency Grizzly Bear Guidelines. U.S. Fish Wildl. Service, Missoula, MT.
KEATING, K. 1986. Historical grizzly bear trends in Glacier National Park, Montana. Wildl. Soc. Bull. 14:83-87.
MERRIAM, C. H. 1922. Distribution of grizzly bears in the United States. Outdoor Life: 405-406.
MURIE, A. 1940. Ecology of the coyote in the Yellowstone. U.S. Govt. Printing Off., Wash. D.C. 206 pp.
U.S. NATIONAL PARK SERVICE. 1987. Draft environmental impact statement, Fishing Bridge developed area, Yellowstone National Park. U.S. Govt. Printing Off., Wash. D.C.
SCHULLERY, P. 1980. The bears of Yellowstone. Yellowstone Lib. and Museum Assoc., Yellowstone Natl. Park, WY. 176 pp.
STORER T., and L.P. TEVIS. 1955. California Grizzly. Univ. Nebraska Press, Lincoln. 335 pp.
U.S. FISH AND WILDLIFE SERVICE. 1982. Grizzly Bear Recovery Plan. U.S. Govt. Printing Off., Wash., D.C. 196 pp.

POLAR BEAR CONFLICTS WITH HUMANS

(Executive Summary Only)

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Executive Summary:[1] Conflicts between polar bears (*Ursus maritimus*) and humans occur every year in the Arctic. Often the result is a dead polar bear; more rarely, a dead or injured human. This concerns management agencies such as Canadian Parks Service and the Department of Renewable Resources, Government of the Northwest Territories because of their dual responsibilities to protect people that live, travel, or work in the Arctic and to maintain viable polar bear populations. These agencies have been developing bear detection and deterrent techniques and implementing programs to minimize bear-human conflicts without having analyzed why such conflicts occur. This study examines that question and uses the answers to recommend techniques to avoid and minimize polar bear-human conflicts.

Agencies known to be responsible for polar bear management were contacted to obtain records of aggressive polar bear-human interactions. Biologists and Inuit hunters were interviewed to augment the review of available literature on ecology, distribution, and behaviour of polar bears. Data on rate of grizzly (*U. arctos*) and/or black bear- (*U. americanus*) human interactions in Canadian and American national parks were collected.

Records of 20 injurious and 353 non-injurious aggressive interactions between polar bears and humans that occurred primarily in the Northwest Territories (NWT) and Manitoba between 1965 and 1985 were collected. At least 230 polar bears were killed. Fifteen men and 1 woman were injured and 6 men were killed. Far fewer people have been injured or killed by polar bears than by black and grizzly bears. Even the rate of human injury and death from black and grizzly bear attacks is low when compared to human deaths by lightning or bites or stings of venomous animals.

No humans have been injured or killed by polar bears in Canadian national parks, national historic parks, or national historic sites; however, several non-injurious aggressive interactions have occurred. The potential for a visitor to Auyuittuq National Park to have such an interaction with a polar bear is higher than for any visitor to a Canadian or American national park containing black and grizzly bears. The potential for such interactions at the Churchill National Historic Park and Sites is probably even higher; however, all bears are deterred from these sites by Canadian Parks Service staff before visitors are allowed access.

Maternal denning areas, summer retreats, fall staging sites, and winter concentration areas within existing or proposed Canadian national parks are identified. Polar bears predictably use these habitats every year. Managers of parks and polar bears can use this knowledge to develop guidelines to reduce risks for park visitors.

A typical polar bear-human interaction in the NWT involved a subadult male polar bear investigating the carcasses at an Inuit hunting campsite, usually between 2400 and 0600 hours when people were asleep or within a shelter. Over ½ of the non-injurious interactions occurred during the 4 ice-free months (August - November). However, proportionately more interactions resulting in human injury or death involved an adult polar bear and occurred at an exploration camp during the winter season.

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[1] FLECK, S., and S. HERRERO. 1988. Polar bear conflicts with humans. NWT Renewable Resources Contract Report No. 3. Available from NWT Dept. of Renewable Resources, Yellowknife, NWT X1A 2L9.

In Manitoba, 2/3 of all aggressive polar bear-human interactions occurred at Churchill. Between December and August, polar bears remain on Hudson Bay sea ice far away from Manitoba. As polar bears come ashore when the ice melts, the rate of interactions increased as polar bear and human concentrations increased. Again subadult male polar bears were involved in more interactions than any other sex and age class.

During most non-injurious interactions, attractants (that is a potential source of food) were present. However, in over half of the injurious interactions, no attractants were present, suggesting that the victim may have been the attractant.

We were able to distinguish several types of attacks by polar bears. Male polar bears typically wounded their victims in the same way as they would kill a seal, that is bites to the head and neck. At least 5 of the 10 male bears consumed part of their victim. In several cases, the bear appeared to have stalked its victim. Nine of 10 bears had to be killed to end the interaction. We feel that these attacks were predaceous. A person involved in an injurious interaction should fight back if she/he suspects that the attack is predaceous.

In contrast, only 1 subadult female and no adult females behaved in a predaceous manner. Only females accompanied by cubs injured humans. The victims were not bitten in the head or neck area and none were killed. In each situation, the victim and female polar bear appeared to suddenly encounter one another without having previously been aware of each other. The female polar bears appeared to perceive humans as threats to their cubs and would attack. Three of the 4 females with cubs ended their attacks on their own initiative. We do not believe that these attacks were predaceous. A person involved in this type of an attack should play dead and protect his/her vital areas during an attack.

Provoked attacks by polar bears appear to be rare. Most polar bears retreated when injured during an interaction.

Deterrents were deployed in 89% of aggressive polar bear-human interactions. Many types of deterrents were tried. Success was variable. Because almost all of the deterrents used in the interactions we collected were different from the deterrents tested by researchers, results are not comparable.

Recommendations to reduce conflicts focus on 5 areas - alertness, avoidance, attractants, detection, and deterrents. People living, working, or travelling in the Arctic should always be alert for the potential appearance of a polar bear. Polar bears can be avoided by learning about polar bear ecology and habitat use. Keeping potential food sources well away from camp sleeping and activity quarters can help to reduce potential interactions. Different types of detection devices are available to give early warning of an approaching polar bear. This allows time to assess the situation and to deploy deterrents. Management agencies can be contacted to determine which deterrents are recommended. Everyone should know how to use the deterrents that are available in a camp.

However, as a last resort, we believe that firearms are a necessity. We emphasize that firearms are only as effective as the person's ability to use them. If a person has no expertise with firearms, a guide who is experienced with firearms and polar bears should be sought. If that option is not available, a person should reconsider his/her itinerary. Since firearms may not be carried within national parks, options available to park managers to reduce polar bear-human interactions include area closures, detection and deterrent programs to keep polar bears and visitors separate, mandatory use of bear-proof camp enclosures, and public education programs.

SECTION IV. BEAR CONFLICTS: PUBLIC EDUCATION AND THE MEDIA

CHAIRMAN: DR. STEPHEN HERRERO, University of Calgary, Calgary, Alberta

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PRESENTING SAFETY IN BEAR COUNTRY INFORMATION TO INDUSTRY AND THE PUBLIC

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Abstract: The Government of the Northwest Territories, in cooperation with industry and other government agencies, initiated a program to address the problem of increasing bear-people conflicts associated with escalating industrial development and other human uses of bear habitat in the NWT. The first phase of the program involved the research and development of bear detection and deterrent techniques. During the second phase, we developed and implemented an information and training program for people living in, working in, or visiting bear country. Industry and the general public, particularly people with little experience with bears, were the primary target audiences. To meet the diverse needs of these audiences, the information program included a manual, booklets, a video, posters, displays, brochures, and a book. We developed training programs for 3 different audiences. We advertised the program through an extensive publicity campaign. Based on the demand for program materials, evaluation of workshops by participants, and a decrease in the number of problem polar bears killed in the NWT, the program appears to be a success.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

When bears and people occupy the same habitat, the potential for conflicts exists. Many bear-people conflicts occur because people living and working in bear country are unaware of or untrained in the use of techniques to prevent or minimize encounters, or do not associate their activities with bear-people conflicts. Bears are attracted to people and their camps out of natural curiosity and in response to attractive odours emitted from garbage and the cooking and storing of food. In the Northwest Territories, the number of bear-people conflicts rose (Schweinsburg and Stirling 1976) with an increase in the number of people. As communities expand and industrial exploration and development continues, the probability of bear-people conflicts increases.

In response to this problem, the Department of Renewable Resources, Government of the Northwest Territories, initiated a program designed to facilitate development of appropriate management strategies to reduce or eliminate conflicts. The first goal of the program was to develop a variety of effective detection and deterrent techniques which could be used in each type of human installation, whether it be a small exploration camp, a large industrial site, or a community. During the first stages of the program, a number of detection and deterrent techniques were tested (Wooldridge 1978, 1980, 1983; Wooldridge and Gilbert 1979; Stenhouse 1982, 1983; Stenhouse and Cattet 1984; Derocher and Miller 1986; Fitch and Fitch 1986; Fitch and Hoos 1986; Clarkson 1987). Although most of the research was completed on polar bears (*Ursus maritimus*), some work was also completed on grizzly bears (*U. arctos*) and black bears (*U. americanus*).

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Throughout the first phase of the program, we compiled and analyzed education and training literature in an effort to develop a basis for the second phase of the program. Phase II was formally initiated in 1983 in order to attain our second goal: to develop and implement education and training programs. This paper summarizes the information and training programs developed.

The work described in this paper would not have been possible without the support of many people and organizations throughout the years. They include Manitoba Department of Natural Resources, Yukon Department of Renewable Resources, Canadian Wildlife Service, Dome Petroleum Ltd., Gulf Canada Resources Inc., Esso Resources Canada Ltd., Mobil Oil Ltd., BP Minerals, Petro Canada Ltd., Cominco Ltd., Department of Indian Affairs and Northern Development, Polar Continental Shelf Project-Energy Mines and Resources, Alaska Department of Fish and Game. We thank M. Shoesmith, I. Stirling, F. McFarland, G. Hobson, R. Quaife, J. Ward, J. McComiskey, H. Monaghan, R. K. Bell, and S. Herrero for their overall support of the project.

ORGANIZATION OF THE INFORMATION AND TRAINING PROGRAM

In order to successfully develop and implement an information and training program, it was necessary to (1) identify our target audiences, (2) determine the type and scope of information most useful to the target audiences, (3) develop information packages and training program outlines, and (4) test the effectiveness of the information packages and the training program outlines.

Based on our experience and understanding of the people most likely to encounter bears, we selected industry and the general public as our primary target audiences. Some difficulties were initially encountered because of the diverse experience, knowledge, and information requirements of these audiences. For example, audiences within the oil industry ranged from personnel working on off-shore oil rigs to workers at seismic camps on the mainland, and ranged from personnel with little or no experience in coping with bear-people conflicts to individuals with considerable experience. We decided to design our program for those people with little or no experience with bears, but simultaneously attempted to develop a program which contained enough information to interest experienced people as well.

To meet these diverse requirements, we incorporated the following into the information and training programs: (1) an explanation of the reasons for bear-people conflicts, (2) bear biology, (3) bear behaviour, (4) techniques to prevent bear-people conflicts, (5) camp and facility design in bear country, (6) bear detection and deterrent techniques, (7) firearm safety, and (8) examples of case histories.

The program was designed to maximize delegate participation whenever possible to encourage people to identify their specific needs and to develop a safety program most suited to those needs.

INFORMATION PROGRAMS

To meet the diverse needs described, programs were developed using a variety of techniques including a manual, booklets, pamphlets, a book, a video, posters, and a display (Figure 1). Some of the information items focus on the biology and behaviour of bears while the rest emphasize safety. Much of the material was developed in cooperation with the Conservation Education Section, Department of Renewable Resources.

Safety in Bear Country Manual

Bromley (1985) produced *Safety In Bear Country: a Reference Manual* as a comprehensive reference for use by people responsible for handling potential bear-people conflicts (e.g., wildlife officers, safety supervisors, park wardens, and camp foremen). The manual was produced in a binder format to facilitate the incorporation of updated information, and contains 8 chapters and 12 appendices. The chapters are entitled (1) an introduction to bear problems and the manual, (2) bear biology, (3) bear behaviour (4) avoiding bear problems, (5) camp design and maintenance, (6) bear detection systems for camps, (7) bear deterrent methods, and (8) firearms and bears. The appendices include problem bear case histories and technical descriptions of detection and deterrent equipment. Since July 1985, we have distributed approximately 1,000 manuals to people in Canada, the United States, and Europe.

Since the completion of the original manual, we have added 2 new chapters: an instructor's guide and a guide

	AUDIENCE			INFORMATION				AMOUNT OF INFORMATION		BEAR SPECIES		
Program	**Agencies**	**Industry**	**Public**	**Biology**	**Safety**	**Management**	**Instructors**	**Brief**	**Detailed**	**Polar**	**Grizzly**	**Black**
SIBC Manual	*	*		*	*	*	*		*	*	*	*
SIBC Booklets												
• Polar Bear		*	*	*	*			*		*		
• Grizzly & Black Bear		*	*	*	*			*			*	*
SIBC Video	*	*	*	*	*			*		*	*	*
SIBC Displays												
• Public			*	*	*			*		*	*	*
• Industry		*		*	*			*		*	*	*
Polar Bear Display			*	*				*		*		
SIBC Posters		*	*		*			*		*	*	
Brochures												
• Polar Bear			*	*				*		*		
• Black & Grizzly Bear			*	*				*			*	*
Polar Bear Book			*	*		*			*	*		
Media Publicity	*	*	*	*	*	*		*		*	*	*
SIBC Workshops	*	*	*	*	*	*	*		*	*	*	*

Figure 1. Safety in Bear Country (SIBC) Information Programs developed by the Northwest Territories Department of Renewable Resources.

for site operations plans. The instructor's guide (Clarkson 1986*a*) was developed to assist trained instructors in program delivery, and to ensure a high degree of consistency in the conduct of all Safety In Bear Country Workshops. The site operations plan (Clarkson et al. 1986*b*) was developed to assist camp foremen, team leaders, and managers to locate and design programs which were safe and met their specific needs. It contains information about emergency contact phone numbers, site design, personnel responsibilities, and techniques to detect and deter bears.

Safety in Bear Country Booklets

Two booklets entitled *Safety In Polar Bear Country* and *Safety in Grizzly and Black Bear Country* were produced and distributed to Renewable Resources offices and visitor information centres. They were written for a general audience, and contain information about (1) the nature, description, and habits of bears; (2) avoiding problems in camp; (3) avoiding problems on the trail; and (4) responding to an encounter with a bear.

Safety in Bear Country Video

A 25-minute video was produced to be used as an introduction or summary for safety in bear country presentations. It reviews bear biology, detection and deterrent techniques, and precautions people can take to avoid or minimize conflicts. The video is available in VHS or BETA formats.

Safety in Bear Country Displays

Two portable displays were constructed for use at conferences, workshops, and seminars. The first display was developed for the general public, and contains information on the biology of bears and precautions people can take while living in bear country. It is comprised of text, maps, and large colour photographs. The second display was developed for industry, and contains information on the biology of bears and on techniques that can be used to minimize bear problems at industrial camps and facilities.

Safety in Bear Country Posters

Conservation Education, NWT Department of Renewable Resources has developed a number of colourful, easy-to-read posters in a variety of languages including English, French, and several native languages used in the Northwest Territories. The posters are displayed in public buildings, industrial camps, schools, and conferences.

Polar Bear and Black/Grizzly Bear Brochures

In addition to information published under the auspices of the Safety in Bear Country Program, the Department has issued 2 brochures (one on polar bears and a second on black and grizzly bears) as part of the Arctic Wildlife Series. The brochures are available to the general public and contain information on the description, habitat, distribution, behaviour, food, reproduction, economic status, and management of bears. The brochures are particularly popular with primary and secondary school students.

Polar Bear Book

The polar bear book, written by Urquhart and Schweinsburg (1984), addresses the life history and geographical distribution of the species. In addition, the book reviews the status of each population in the Northwest Territories. The book contains photographs and maps, and is recommended for people interested in detailed information about the polar bear in the Northwest Territories.

TRAINING PROGRAMS

Safety in Bear Country Workshops

Workshops were designed and implemented in order to train people with a variety of backgrounds and experience in the art and science of coping with potential bear-people conflicts. Three types of workshops were implemented:

1. A 1-day workshop for people who perform duties relating to the distribution of information about bear-people conflicts (e.g., park attendants and tourist information officers).
2. A 2-day workshop for people responsible for dealing with bear-people conflicts (e.g., wildlife officers, safety foremen, camp attendants, park wardens, and team leaders).
3. A 4-day workshop to train Safety in Bear Country instructors (Clarkson 1986*b*).

The workshops were designed to maximize involvement of participants in the lectures and discussions. The Safety in Bear Country manual is used as the textbook for each workshop. The manual is supplemented with the video, demonstrations, and movies. The 2-day workshop and the instructors workshop are supplemented with a field training session during which participants receive instruction in the correct use of detection equipment, deterrent techniques, and firearms.

MEDIA COVERAGE AND PUBLICITY

The success of any training and education program that has been designed for the general public and industry is in part determined by the way in which the program is advertised and promoted. In order to convey the message in a manner that would interest these groups, we embarked upon an extensive publicity campaign. Local radio interviews, a short television spot, and magazine and newspaper articles were used to make the public aware of the existence of the Safety in Bear Country program. In addition, the program was featured by "Westland" a program aired on the British Columbia Knowledge Network, and acknowledged in a program produced by Mutual of Omaha's "Wild Kingdom".

We believe that the time and effort spent promoting the program by assisting writers, reporters, and producers, and by encouraging the distribution of information through the various media, significantly enhanced the public's awareness of the training and education program.

PROGRAM EVALUATION

A formal evaluation of the complete information and training program was not conducted; however, some aspects were evaluated, and inferences can be made about the effectiveness of other components of the program. The program has certainly increased the awareness of safety in bear country with industry and the public. With over 1,000 manuals and thousands of brochures distributed throughout the Northwest Territories and other parts of North America, it can be presumed that many people are better informed about preventing and managing conflicts with bears. The manual has been used as a reference book by several agencies in Canada and the United States.

The Safety in Bear Country workshops were evaluated by participants at the end of each workshop. The evaluations indicated that the participants were pleased with the information and training they received, and that they felt they knew more about preventing and managing bear problems. Further contact with industry and government agency personnel after the workshops indicated that they were able to use the information and training received. Most of the participants in the instructors workshop have been giving their own workshops in their jurisdictions.

Within the Department of Renewable Resources, the awareness of and concern for preventing bear problems, and managing problems more effectively when they occur, have increased as a result of the information and training made available. Two years after the program began, the number of reported kills of problem polar bears in the Northwest Territories was reduced from 40 in 1981 to 15 in 1983 (Clarkson et al. 1986*a*). Although the reduction may not be attributed entirely to the program, the program played a major role.

CONCLUSION

Information and training programs are important to ensure that information is presented to the public and industry in a practical and useful format. The information requirements of people living and working in bear country are diverse; hence, the training and education program must be sensitive to the unique requirements of these people. In addition, it is important that the programs be consistent and continually updated. This requires a long-term commitment on behalf of the sponsoring agency.

LITERATURE CITED

BROMLEY, M. 1985. Safety in bear country: a reference manual. NWT Dept. of Renewable Resources, Yellowknife. 120 pp.

CLARKSON, P. L. 1986*a*. Safety in bear country instructors guide. NWT Dept. of Renewable Resources, Yellowknife. 32 pp. (Mimeo).

_____. 1986*b*. Safety in bear country workshop outlines. NWT Dept. of Renewable Resources, Yellowknife. 32 pp. (Mimeo).

_____. 1987. Bear deterrent study, Cape Churchill, Manitoba, 1985. File Rep. No. 66. NWT Dept. of Renewable Resources, Yellowknife. 58 pp.

_____, P. A. GRAY, J. E. McCOMISKEY, L.R. QUAIFE, and J.G. WARD. 1986*a*. Managing bear problems in northern development areas. Pages 47-56 *in* M. Lewis, eds. Northern Hydrocarbon Development Environmental Problem Solving Proceedings, Banff, Alberta, 1985.

_____, G.E. HENDERSON, and P. KRAFT. 1986*b*. Problem bear site operation plans. NWT Dept. of Renewable Resources, Yellowknife. 12 pp. (Mimeo).

DEROCHER, A.E., and S. MILLER. 1986. Twelve gauge ferret shell tests on polar bears, Cape Churchill, Manitoba, 1984. File Rep. No. 54. NWT Dept. of Renewable Resources, Yellowknife.

FITCH, R., and K. FITCH. 1986. A study to evaluate the applicability of acoustic stimuli as an effective polar bear (*Ursus maritimus*) deterrent, Cape Churchill, Manitoba. Pages 17-32 *in* Infra-red detection and acoustic deterrent study, Cape Churchill, Manitoba, 1984. File Rep. No. 55. NWT Dept. of Renewable Resources, Yellowknife.

_____, and L. M. HOOS. 1986. A study to evaluate infra-red thermography techniques for detecting polar bears (*Ursus maritimus*) at Cape Churchill, Manitoba, November, 1984. Pages 2-16 *in* Infra-red detection and acoustic deterrent study, Cape Churchill, Manitoba, 1984. File Rep. No. 55. NWT Dept. of Renewable Resources, Yellowknife.

SCHWEINSBURG, R.E., and I. STIRLING. 1976. More research needed to minimize conflicts between men and polar bears. Oilweek (March 5). 2 pp.

STENHOUSE, G. B. 1982. Bear detection and deterrent study, Cape Churchill, Manitoba, 1981. File Rep. No. 23. NWT Dept. of Renewable Resources, Yellowknife. 65 pp.

_____. 1983. Bear detection and deterrent study, Cape Churchill, Manitoba, 1982. File Rep. No. 37. NWT Dept. of Renewable Resources, Yellowknife. 58 pp.

_____, and M. CATTET. 1984. Bear detection and deterrent study, Cape Churchill, Manitoba, 1983. File Rep. No. 44. NWT Dept. of Renewable Resources, Yellowknife. 59 pp.

URQUHART, D., and R. SCHWEINSBURG. 1984. Polar bear life history and distribution in the Northwest Territories up to 1981. NWT Dept. of Renewable Resources, Yellowknife. 70 pp.

WOOLDRIDGE, D. R. 1978. Deterrent and detection systems. Rep. to Govt. NWT, Yellowknife. 55 pp.

_____. 1980. A field study of electronic polar bear detection and deterrent devices: Churchill, 1980. Rep. to Govt. NWT, Yellowknife. 60 pp.

_____. 1983. Polar bear electronic deterrent and detection systems. Int. Conf. Bear Res. and Manage. 5:264-269.

_____, and B. K. GILBERT. 1979. Polar bear detection and deterrent systems. Rep. to Govt. NWT, Yellowknife. 37 pp.

PROBLEMS BETWEEN WILDLIFE SCIENTISTS AND THE MEDIA

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Abstract: The relationship between the scientist and the media is often not a cooperative one. Many scientists accuse the media of sensationalizing stories about bear-people conflicts, and blame the media for the reactionary response of the public. Wildlife scientists need to recognize that they can use the media to promote the best interests of wildlife by understanding how the media works, and developing an effective strategy for communication. Sensationalism of stories is generally not deliberate, but is caused by inexperience and ignorance of the subject on the part of the journalist assigned to the story. Scientists should take into account the limitations of the journalists and the immediacy of their needs. When working with general assignment reporters, it is important to convey the information in simple, easily understandable terms. It is a good idea to establish a long-term contact with an environmental writer. In some cases, special units within a government agency can be appointed to answer all wildlife-related inquiries by the media. Wildlife scientists not associated with government can work together to support the government media strategy or to provide another informed opinion on controversial decisions. If all else fails, complaining usually gets results. Refusing to talk to the media is not an effective solution.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Bear attacks are extraordinary occurrences. Rates of injury to back-country hikers in the 1970's ranged from 1 injury per 2,620 back-country-use days in Mount Revelstoke and Glacier National Parks in Canada, to 1 injury per 59,300 back-country-use days in Yellowstone National Park (Herrero 1976). While surveys indicate that most people do not want to see bears destroyed, even after they have attacked people or caused property damage (Pelton et. al. 1976), negative public reaction does occur. In a number of instances, this has influenced wildlife management decision-making in ways that may be perceived as detrimental to the best interest of the bear or other wildlife species. It has not been uncommon to have bears and wolves (*Canis lupus*), for example, culled from certain wilderness areas to appease concerns about bear attacks or to rectify perceived incidents of overpredation.

Many scientists blame the media for this highly reactionary response. The general perception is that journalists sensationalize stories about bear attacks and wildlife management decision-making. As a result, the relationship between the media and scientists has not always been a cooperative one. In fact, many scientists refuse to speak to the media for fear that what they say will be oversimplified, placed out of context, or sensationalized. While such a strategy has obvious short-term benefits in the sense that no news is good news, it can be detrimental in the long-term as this paper will point out.

A more productive alternative is for wildlife scientists to recognize that the media can be used to promote the best interests of wildlife and wilderness. Positive newspaper, magazine, or television stories about animals have a significant impact on the public, often more so than years of research by a scientist. What is needed then is a sound strategy in communicating with the media for the benefit of wildlife, whether it be bears or any other animal species. The strategy requires a basic understanding of how the media works and why sensationalism often develops in the coverage of wildlife issues. It also requires a system of communicating with the media, either on a person-to-person basis, or on a systematic level to prevent the sensationalism from occurring. Even when this fails, there are avenues of appeal that can help prevent a repeat occurrence.

I conducted a survey of one major Canadian daily newspaper which publishes numerous wildlife-related stories because of its proximity to wilderness. I assessed and compared all of the articles relating to bears that were published in 1981 and 1987. The survey indicated that, indeed, a significant number of stories relating to bears and bear-people conflicts might be categorized in part or whole as sensationalistic or, according to the Oxford English Dictionary, "violently exciting facts calculated to produce a startling impression".
The same survey, however, indicated that the quality and educational value of the stories have improved over the years, and with the number of more experienced and specialized journalists who have an interest in the subject.

REASONS FOR SENSATIONALISM

There is a reason why sensationalism pervades the news pages after a bear-person conflict. The case of the "Killer Bear of Whisky Creek", which appeared in several articles in the Edmonton Journal, Calgary Herald, and other Canadian newspapers throughout August 1980 is a classic example. In August of that year, a grizzly bear (*Ursus arctos*) killed 1 man and attacked 6 others in 3 separate incidents at Whisky Creek in the Rocky Mountain resort town of Banff, Alberta in Canada. The incidents attracted the kind of national attention usually appropriated to a mass murderer. Indeed, the stories portrayed the animal almost as if it was a deranged killer. One headline read "FEAR, ANXIETY ENGULF TOWN" (Edmonton Journal, August 25, 1980). The story described the animal as the "killer grizzly stalking this resort town . . . unleashing a wave of fear and anxiety."

Parks Canada (Canadian Parks Service) officials whom I interviewed indicated that the media reports resulted in an unprecedented level of local public pressure to have the animal destroyed. As a result, one large black bear (*U. americanus*) which was not responsible for the mauling was killed during the pursuit to find the problem bear. When officials finally destroyed the real problem bear, no words were spared by the media to describe the scene. Accompanying a front page photo of the dead bear hanging from the end of a rope, the newspaper headline read "A TOWN BREATHES EASIER, KILLER BEAR GUNNED DOWN" (Edmonton Journal, August 26, 1980). Part of the story reads as follows:

> Like mourners at a funeral, Banff residents filed by the warden's compound here Thursday for a look at the killer bear of Whisky Creek.
>
> The temptation of a baited beaver trap provided the undoing of the rogue grizzly who had stalked their town for eleven days, killing one man and attacking three others.
>
> The bear's foot was snared and in a desperate attempt to free himself, he ripped off the greater part of his left paw.
>
> In a last defiant act, the killer lunged at armed park officials when they approached him in the dense underbrush. It took five close-range blasts to kill the bruin. The giant male grizzly was lowered to the ground from a helicopter by a harness 100 metres from the warden's office.
>
> Word of the 8:17 a.m. shooting spread quickly through town and throngs of local residents flocked to the compound fence. Their faces pressed against the compound fence, spectators watched in awed silence as park officials examined the gaping jaws and paws the size of a man's head on the 338-kilogram monster.
>
> Thursday's drama ended a violent rampage by the killer bear which left this small community paralysed with fear . . .

The article was placed on the front page of the newspaper. Buried in the final paragraph of the story was a Parks Canada (Canadian Parks Service) statement that put the incident within the proper context - Banff is a safer place than downtown Edmonton. Even further back in the paper, in a separate story, was key information that explained the reasons for the attack - 3 of the victims were fishermen who had inadvertently got in between the bear and its food cache.

Wildlife scientists may interpret such coverage as a deliberate attempt by the media to sensationalize the subject matter for the purpose of attracting readership. However, most reputable newspapers do not inherently set out to produce such drama. These articles get written because of ignorance on the part of the media and the public. Unlike the scientist or wildlife manager who deals with wildlife-related issues on a daily basis, the public and the media enjoy no such luxury. Their closest contact with a bear is within the context of a zoo, television program, or newspaper, where it is easily anthropomorphized.

Newspapers and other daily media reports have trouble dealing with bear-people conflicts and other wildlife-related issues because they occur so infrequently in a way that has mass appeal. When they do occur, media managers generally assign the story to a "general assignment" or "police" reporter (most deaths, whether criminal or accidental, fall into the latter category). General assignment reporters are often assigned the job because they are usually available on a moment's notice. Police reporters are chosen because they deal primarily in a field where crime, terror, and personal tragedy are the norm. There is considerable debate about the pros and cons of the way they cover their beats, even within newspaper circles; but sobbing mothers, vigilante fathers, fearful neighbours, and a motive for the killing are generally accepted to be the formula for a good story. A mysterious or strange killer almost guarantees that it will get front-page coverage. The bear attack nicely provides all of the above ingredients.

In the course of establishing a media strategy, wildlife scientists and managers must accept these basic facts and their apparent limitations. They must also accept the fact that the journalist, when assigned to a story, has a professional obligation to return with information pertinent to the incident. For daily newspaper operations, the information must be gathered in a matter of hours. Therefore, if the scientific community or government agency does not respond quickly to a wildlife issue such as a bear attack, the journalist is likely to get information from a less-informed source.

STRATEGIES FOR DEALING WITH THE MEDIA

A media strategy should be developed to deal with the immediacy of the situation and to meet the professional requirements of the journalist. For the general assignment or police reporter, it will require the dissemination of information in simple terms that can be comprehended easily.

Establishing Contacts with Environmental Writers

There is a more effective, however long-term, strategy that can be developed to respond to such cases. In the survey mentioned earlier, the most informative reports relating to bear-people conflicts were written by the newspaper's environmental writer or someone with a keen interest in the subject. Whenever possible then, it would be wise for an individual scientist or group of scientists to establish contact with such a writer. One simple way would be to keep the journalist informed of developments in wildlife research. The scientist might even suggest ideas for stories. When a sensitive matter does arise, the same journalist can be contacted or tipped off, thus ensuring that a more qualified person will be involved in covering the story.

The Case of Churchill, Manitoba • Such a strategy is not always going to produce the intended results. But it is much more effective than refusing to speak to the media. The polar bear (*U. maritimus*) situation at Churchill, Manitoba demonstrates why. Each autumn, large numbers of polar bears congregate near the town waiting for the sea ice to form so they can return to hunting seals. Injury or death due to bear problems have been infrequent. However, when they have occurred, public reaction and media response have often elevated the threats far out of their true proportions. A fatality that occurred in Churchill in 1983 as a result of a bear attack demonstrated this.

It was an incident in which I had first-hand experience. While on my way to a polar bear research camp near Cape Churchill, I was forced to overnight in the town of Churchill. Soon after I went to sleep in one of the local hotels, I was wakened to the sound of a screaming man outside my window. When I drew the curtains, I saw a polar bear with its jaws clamped around a man's head, shaking the life out of him. By the time I and the Northwest Territories biologist who was accompanying me to the research camp got outside, chaos had broken out. A number of townspeople had surrounded the bear, trying to scare it off with broomsticks and baseball bats. The subadult bear bluff-charged them several times. The bear was finally destroyed by a man who shot through the crowd several times before finally hitting the animal. It was fortunate that no one in the crowd was shot by the man or maimed by the bear.

The headlines over the next few days in newspapers across the country left nothing to the imagination. There were the stereotypical stories about the polar bear stalking the man in the middle of the night in Canada's polar bear capital - the bravery of the man who shot the animal and saved the townsfolk. But the most disturbing aspect of many of the newspaper stories and radio and television reports was the underlying expectation that something needed to be done to avenge the man's death. The regional president of the Fish and Game Association represented the opinion of many people in recommending that the local bear population was growing out-of-control and losing its fear of people. In order to rectify this, a legalized hunt needed to be instituted, he advised.

The Manitoba government stopped short of allowing a legalized hunt. But to alleviate public concern, it did order a round-up of all bears within a certain radius of the townsite. Extra personnel were flown in. A helicopter was used to fly bears out to the sea ice. At least 1 bear was destroyed as a result of a tranquillizer that had penetrated too deeply.

While the media reports focused on the community's concerns, the public hysteria, and the eventual bear round-up, it missed reporting several important facts. One of the most important was that the man who was mauled to death was intoxicated at the time of the attack, and searching through the rubble of a hotel fire in the middle of the night. It was evident that he was not being stalked by the bear. More likely, the bear was simply searching through the rubble as well.

Another important fact missed in many reports was the motives of the local Fish and Game Association regional president. As a hunter, it would be in his and his organization's interests to see a legalized hunt. It was also never pointed out that the president of the association had encountered a number of previous problems with bears near his own dwelling, where he insisted on raising pigs and chickens even though he was warned that the fenced-in animals would be tempting prey for the polar bears. There was clearly an ulterior motive behind his recommendations.

Most importantly it was never reported that the efforts of the Manitoba government, and the life of at least 1 bear, were wasted in light of the fact that the ice on the Hudson Bay was only days away from freezing enough to facilitate the bears' escape. In the end, this is exactly what happened.

Had a proper media strategy been developed, many of the unfavourable occurrences could have been avoided. To the credit of the Manitoba government, such a strategy has been developed and improved since then to deal with the annual Churchill situation. A special unit is now appointed to answer the media inquiries from across the country.

The strategy has produced notable results according to Churchill and Manitoba officials. More than ever before, there is a general acceptance on the part of the public that polar bears are a fact of life in the community. As well, many stereotypical images of a community being held hostage each year to the annual polar bear migration, which traditionally appeared in the media reports, have been dispelled.

The Role of the Non-Government Scientific Community

There are, however, limitations to such a government-run media strategy. The first is the fact that not all governments make decisions that are in the best interests of wildlife management. Predator control programs, particularly ones that have been launched in the Yukon Territory, British Columbia, and Alberta in recent years illustrate this point.

In Alberta, for example, the government's wildlife managers insisted that the grizzly bear population in the Kananaskis country must be thinned out through a legalized hunt in order to prevent bear-people conflicts and to open up habitat for competing younger bears. Hunting, the government argued, is a true-and-tried conservation tool that can be used to thin out the ranks of male grizzlies - especially the old and dangerous boars - in order to provide adequate habitat for the rest of the species to survive.

However, there is some scientific reason to believe that the government's position regarding the Kananaskis hunts, and indeed other hunts like it, is not always based on scientific fact. Herrero and others in the non-governmental scientific community, took issue with the government's contention that there were between 50 and 100 bears in Kananaskis. Launching such a hunt could, in fact, result in the elimination of the bear population from the area, they argued.

Under such circumstances, it would be more effective for a non-governmental group of scientists to reinforce the government media strategy or to provide the second informed opinion where it may be necessary to counter government action. This kind of collective effort reduces the embarrassing or dangerous necessity for a single scientist to take a bold step in questioning government action. The weight of a professional group is also more influential than the opinions of just 1 person. The strategy required is not unlike that currently being used by other non-governmental groups, and could, in fact, be used in concert with the efforts of environmental groups working towards the same purpose.

Complaining

Where such efforts fail and the media continues to sensationalize issues, there are other courses of action besides throwing up one's hands in disgust and refusing to talk to the media. The best alternative is to complain. Nothing gets a quicker response from reputable media organizations. There are several ways of doing this. The best way is to phone the editor and follow it up with a letter outlining concerns about the article or report. The phone call will likely result in the editor taking action to ensure that the situation does not recur. The letter, if published or aired as it is likely to be by reputable media organizations, will set the record straight in a public forum. It should be noted that Letters-to-the-Editor sections are among the best-read parts of a newspaper. Reporters who get too many reasonable complaints about the tone or facts of their stories will have to respond accordingly. Otherwise, their position or job may be on the line.

If these 2 procedures fail to produce the results, the complainant has the option of writing a letter to the newspaper's ombudsman, or failing that, to the regional Press Council of which the media organization is a member. If there is a supportable point to make, then the watchdogs of the industry are required to listen and take action. While neither can do anything to penalize the media organization, their censure has significant professional and moral clout.

CONCLUSION

The fact is that the media is not perfect, particularly in its dealings with wildlife-related issues and bear-people conflicts. Sensationalism in reporting does occur, but not intentionally. Scientists must recognize that refusing to speak to the media is not an effective way to deal with the problem. What is required is a sound media strategy which takes into account the limitations of the journalists, the knowledge of the public, and the immediacy of the situation. Scientists must know who they are working with and how to get their message across. They must also act in concert to ensure that there is no second-guessing of the motives of an individual. Only then will the best interest of scientists and wildlife be secured in the public arena.

LITERATURE CITED

HERRERO, S. 1976. Conflicts between man and grizzly bears in national parks of North America. Int. Conf. Bear Res. and Manage. 3:121-146.

PELTON, M. R., C. D. SCOTT, and G. M. BURGHARDT. 1976. Attitudes and opinions of persons experiencing property damage and/or injury by black bears in the Great Smoky Mountains National Park. Int. Conf. Bear Res. and Manage. 3:157-168.

IN MY OPINION . . .

CARNIVORES SHOULD BE MANAGED, NOT OVERPROTECTED

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Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

The increase in bear-human conflicts is well documented (Graber and White 1978, Hastings et al. 1981, Graber 1982, Martinka 1982, McCullough 1982, Jope 1985, Klaver et al. 1985, Keating 1986). Healthy reproducing populations of bears, mountain lions (*Felis concolor*), and wolves (*Canis lupus*) cannot tolerate human communities any more than domestic livestock can cohabit with high numbers of these carnivores. There is little sense of reintroducing or encouraging recolonization of grizzly bears (*Ursus arctos horribilis*) or other large carnivores into their former range unless there is a good chance that they will reproduce, which means it is inevitable that they will multiply beyond the carrying capacity of the habitat.

Bears, like most large carnivores, partially regulate their population density, even where food may not be limiting, by territoriality, including cannibalism (Dean et al. 1986; Tietje et al. 1986; Schoen et al. 1987). While I was in Kanha National Park, Madhya Pradesh, India, in January 1982, 2 male tigers fought to the death, with the winner cannibalizing the loser.

In environments people have partially altered, nature seldom "knows best", thus bears and other wildlife populations should be managed and/or controlled and not left to the whims of nature (Howard 1985, 1986). If you really love bears and have genuine empathy for wild animals, you must consider the long-range effects of any temporary kindness you may offer individuals or populations.

An overpopulation of bears, in fact of any large carnivore, can be dangerous if humans are also numerous. Since 1975, 13 children have been attacked, 1 fatally, by coyotes (*Canis latrans*) in Los Angeles, California. There has been no hunting of mountain lions in California from 1971 to 1988, and in 1987 a 5-year-old girl and a 6-year-old boy were seriously mauled by lions. Earlier, 6 other lion attacks had occurred in California, and 39 in the United States (Fitzhugh and Gorenzel 1986). In 1982 "surplus" tigers from Indian parks and preserves killed about 150 people (Howard 1982).

We must not let extreme animal rights and humane groups - or biologists, for that matter - regulate carnivore populations with just "emotions", for in the end, it will cause unnecessary suffering for both the animals and people. A death ethic is needed. In human-altered ecosystems nature can be humanized with modern hunting, fishing, and animal control practices. In modified environments to "leave it to nature" is a mistake. Once people have altered the environment, all wildlife populations should be managed or controlled (Howard 1984).

Since I do not expect sport hunting or official killing of "surplus" animals to be accepted in United States national parks for some time, what can be done? Much progress has been made in keeping bears from becoming conditioned to people's garbage, the key issue (Knight et al. 1988). State or provincial game departments must ensure that surplus bears leaving the parks or preserves are adequately harvested.

Research is needed to develop ways of making bears, lions, and wolves more wary of people where hunting is not allowed (McCullough 1982), as protection from harassment and pain from humans, and increased friendly exposure to people, will cause them to lose some of their innate fear of people (Jope 1985). Since grizzly bears are known to be highly mobile and to range and disperse over great distances (Knight and Eberhardt 1984, 1985; Knight and Judd 1983), it is paramount that a very large area, much larger than Yellowstone National Park, be available to support a sustainable, free-ranging grizzly population. More research may be needed to better understand the habitat requirements of grizzlies, although much is already known (Craighead et al. 1982, Zager and Jonkel 1983). Sometimes it is possible for sheep or cattle permittees to be shifted by the Forest Service to another allotment, as in Targhee National Forest (Orme and Williams 1985).

Relocation of bears is not a simple solution to problem animals, for they may return from great distances (Rutherglen and Herbison 1977, Rogers 1986), and those that do not return can be considered ecologically dead (Graber 1982). Most relocations are inhumane because of the difficulty such animals experience while searching, usually in vain, for a mate and vacant niche.

Another technique for holding grizzly bears in a limited area like Yellowstone is to create John J. Craighead's proposed food-source ecocentres (Fischer 1983). This would help hold a population possibly large enough to be genetically viable. Even polar bears (*U. maritimus*) will learn to use supplemental food sources (Lunn and Stirling 1985). Some grizzlies may not reproduce until 5 or more years of age (Schoen et al. 1987); however, I suspect this is partly due to inadequate nutrition due to an overpopulation of bears because such bears are certainly more fecund when they have access to human garbage. In the Olympic Peninsula, Washington, supplemental feeding helped reduce debarking of conifers by black bears (Flowers 1987).

Any grizzly or other large carnivore that ventures out of its allotted zone should immediately lose all its protected status. Under Arizona law (ARS 17-302), livestock operators may take a "stock-killing" bear at any time (LeCount 1986). Bears should not be overprotected or classified as endangered species. It is better to make them game animals so that biologists rather than politicians are the ones to recommend appropriate harvests when necessary.

LITERATURE CITED

CRAIGHEAD, J. J., J. S. SUMNER, and G. B. SCAGGS. 1982. A definitive system for analysis of grizzly bear habitat and other wilderness resources. Wildlife-Wildlands Inst., Monogr. 1, Univ. Montana, Missoula. 279 pp.

DEAN, F. C., L. M. DARLING, and A. G. LIERHAUS. 1986. Observations of intraspecific killing by brown bears (*Ursus arctos*). Can. Field-Nat. 100:208-211.

FISCHER, H. 1983. Voice for the grizzlies. Defenders 58:4-17.

FITZHUGH, E. L., and W. P. GORENZEL. 1986. Biological status of mountain lions in California. Pages 336-346 *in* T. P. Salmon, ed. Proc. 12th Vertebr. Pest Conf., Univ. California, Davis.

FLOWERS, R. H. 1987. Supplemental feeding of black bear in tree-damaged areas of western Washington. Pages 147-148 *in* D. M. Baumgartner, R. L. Mahoney, J. Evans and J. Caslick, co-chairs. Animal damage management in Pacific Northwest forests, Spokane, WA.

GRABER, D. M. 1982. Ecology and management of black bears in Yosemite National Park. Western Region, Natl. Park Serv., Coop. Natl. Park Tech. Rept. 5, Univ. California, Davis. 206 pp.

_____, and M. WHITE. 1978. Management of black bears and humans in Yosemite National Park. Cal-Neva Wildlife: 42-51.

HASTINGS, B. C., B. K. GILBERT, and D. L. TURNER. 1981. Black bear behavior and human-bear relationships in Yosemite National Park. Western Region, Natl. Park Serv., Coop. Natl. Park Tech. Rept. 2, Univ. California, Davis. 42 pp.

HOWARD, W. E. 1982. A tiger problem in India. Pages 47-49 *in* R. E. Marsh, ed. Proc. 10th Vertebr. Pest Conf., Univ. California, Davis. 245 pp.

_____. 1984. Balance of nature: fiction and reality. Trans. N. Amer. Wildl. and Natur. Resour. Conf. 49:469-479.

_____. 1985. Ecology of wildlife management in disturbed environments. Proc. West. Assoc. Fish and Wildl. Agencies Conf. 64:123-132.

_____. 1986. Nature and animal welfare: both are misunderstood. Exposition Press of Florida, Pompano Beach. 67 pp.

JOPE, K. L. 1985. Implications of grizzly bear habituation to hikers. Wildl. Soc. Bull. 13:32-37.

KEATING, K. A. 1986. Historical grizzly bear trends in Glacier National Park, Montana. Wildl. Soc. Bull. 14:83-87.

KLAVER, R. W., J. J. CLAAR, D. B. ROCKWELL, H. R. MAYS, and C. F. ACEVEDO. 1985. Grizzly bears, insects, and people: bear management in the McDonald Peak Region, Montana. Proc. Grizzly Bear Habitat Symp., U.S. For. Serv., Intermountain Res. Sta. Gen. Tech. Rept. INT-207:204-211.

KNIGHT, R. R., B. M. BLANCHARD, and L. L. EBERHARDT. 1988. Mortality patterns and population sinks for Yellowstone grizzly bears, 1973-1985. Wildl. Soc. Bull. 16:121-125.

_____, and L. L. EBERHARDT. 1984. Projected future abundance of the Yellowstone grizzly bear. J. Wildl. Manage. 48:1434-1438.

_____, and _____. 1985. Population dynamics of Yellowstone grizzly bears. Ecol. 66:323-334.

_____, and S. L. JUDD. 1983. Grizzly bears that kill livestock. Int. Conf. Bear Res. and Manage. 5:186-190.

LECOUNT, A. L. 1986. Black bear field guide: a manager's manual. Arizona Game and Fish Dept., Spec. Rept. 16. 130 pp.

LUNN, N. J., and I. STIRLING. 1985. The significance of supplemental food to polar bears during the ice-free period of Hudson Bay. Can. J. Zool. 63:2291-2297.

MARTINKA, C. J. 1982. Rationale and options for management in grizzly bear sanctuaries. Trans. N. Amer. Wildl. and Nat. Resourc. Conf. 47:470-475.

McCULLOUGH, D. R. 1982. Behavior, bears, and humans. Wildl. Soc. Bull. 10:27-33.

ORME, M. L., and R. G. WILLIAMS. 1985. Coordinating livestock and timber management with the grizzly bear in Situation 1 habitat, Targhee National Forest. Proc. Grizzly Bear Habitat Symp., U.S. Forest Serv., Intermountain Res. Sta. Gen. Tech. Rept. INT-207:195-203.

ROGERS, L. L. 1986. Effects of translocation distance on frequency of return by adult black bears. Wildl. Soc. Bull. 14:76-80.

RUTHERGLEN, R. A., and B. HERBISON. 1977. Movements of nuisance black bears (*Ursus americanus*) in southeastern British Columbia. Can. Field-Nat. 91:419-422.

SCHOEN, J. W., S. D. MILLER, and H. V. REYNOLDS III. 1987. Nat. History 96:50-61.

TIETJE, W. D., B. O. PELCHAT, and R. L. RUFF. 1986. Cannibalism of denned black bears. J. Mamm. 67:762-766.

ZAGER, P. E., and C. J. JONKEL. 1983. Managing grizzly bear habitat in the northern Rocky Mountains. J. For. 81:524-526.

BANQUET ADDRESS

DO CARNIVORES HAVE A FUTURE?

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Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

I was invited this evening to broaden the discussion of this conference beyond bear safety considerations, to the conservation of large carnivores in general. As you can see from my title, that's what I'm going to try to do.

I'd like to begin on a personal note, and those of you who have heard me speak before know it's too bad but there's no stopping me in this regard. However, I was raised in a hydro camp in the bush in northwestern Ontario, so bears have been a fact of life for me, not just something I've read about. Really I have to be careful here, because between my own experiences and stories I've heard, I think I could rival almost anyone in this room at least in terms of the sheer number of tales I've come across. Have you noticed that there's something about bear stories that makes them stick in your mind? Perhaps it's because they get richer and always more exaggerated as they are retold.

At any rate, as a kid I was taught to regard bears with what I could best describe as a healthy blend of fear and respect. There was also an element of contempt in there, because where I was brought up, bears were regarded as pests - *dangerous* pests. Put less politely, the only safe bear was a dead one.

Looking back, it now seems that most of my bear stories ended with the animal getting shot. For example, a big brown-phase black bear was shot not 50 metres from our house at Whitedog Falls. I took a photo of it with an old Brownie Hawkeye camera and for some reason that picture continues to have a powerful effect on me. The bear was shot in summer just at dusk as I was drifting off to sleep - nine times from a Winchester 30/30 model 94. Since the shooter was standing almost right under my window, the noise startled the hell out of me. There was a great commotion, of course the camp dogs went crazy, and I remember everyone gathering around the carcass with flashlights. I also remember the unanimous opinion that everyone, especially women and children, could go to bed feeling a little safer that night.

Like I said, the only safe bear was a dead one.

I have a million other stories which I'll spare you, about bears shot in the dump, bears shot on the streets, bears breaking into food tents, bears ripping open canoes smelling of dead fish, sows and cubs scattering garbage cans, bears chasing hunters up trees, bears in traps, and on and on ... The common theme here, of course, is that bears are a *problem*.

I also have some other recollections. Bears ambling along wild beaches, black bears fishing, polar bears gathering on Cape Churchill, grizzlies in wild berry patches, bear cubs wrestling totally unaware that I was watching, and a huge polar bear carcass washed up on Hudson Bay - an old male that as far as we could tell died at the hands of nature not man.

Here, then, is the *other* image of large carnivores. For if bears can be a problem in relation to people, they can also be a symbol of wilderness and the extent to which some parts of the planet are not yet overrun by people and the problems they bring.

The same could be said of wolves which I also know very well, and perhaps cougars which I don't. To the extent that Canada still has self-regulating populations of these large carnivores, we still have a wild country. They are the top predators whose presence indicates that the other trophic levels of the system are still in shape. In short, I believe the decisions we make about the conservation of large carnivores reflect more basic decisions about whether or not we want wilderness to be part of this country's future.

Twenty-six years ago Doug Pimlott put it directly to all of us when he said (using the wolf as his example), "The wolf poses one of the most important conservation questions of our time. Will the species exist when the twentieth century passes into history?" He also asked a related and equally fundamental question, "Should reasonable portions of Canada be reserved in perpetuity from the processes of commercial exploitation?" I suggest that you would be hard-pressed to answer one question without answering the other.

So what would be a fair assessment of our decisions to date? Before answering this, I'd like to point out that with a few important exceptions, we still *have* a choice in Canada as to whether or not we want to ensure a future for large carnivores. This opportunity has certainly been lost by most of the rest of the world. But sadly, mankind as a species doesn't seem to yearn for what we've had 'till it's gone - to paraphrase Joni Mitchell. In my view, Canadians should be grabbed by the shoulders and shaken until they do three things:

Number one, stop taking our wildlife richness for granted.

Number two, reflect on the mistakes made by others and determine that we will not repeat them.

Number three, define what kind of country we want in the future so we can backtrack to make decisions *now* that ensure we get what we want.

Let me now translate what I think those points mean for specific concerns surrounding large carnivores.

First, and most important, we must decide provincially and nationally whether or not we are going to legally protect a network of wilderness areas large enough to allow wild carnivores to be carnivores. I think we know already where these areas are. In B.C., for example, perhaps it wouldn't hurt so much to see the Khutzeymateen Valley being lost to logging, if that province showed signs of designating *other* areas as grizzly reserves. If you wish, I'm saying let's make a deal. If you want to wreck an area, show us that you're going to protect another. Wreck one - protect one. But above all show us a clear commitment to assembling a network of reserves sufficient to ensure that B.C. will have grizzlies in perpetuity.

Of course this is *not* what's happening. We're losing areas to be sure. *That* side of the equation is proceeding nicely. But we're not adding. Not just in B.C., but in Canada. We have no clear vision of what we need. We have no measuring stick to show how important everything is that's being chipped away. Call it loss by default, call it creeping incrementalism, call it what you want. It's classic Canada. And *we*, the conservation community, must accept a fair share of the blame. We react and complain on an ad hoc basis as each gem is lost, but we are unable to state clearly what the assembled crown must look like. I warn you: no dreams, no visions, no stated goals - no bears, no wolves, no cougars.

In connection with this, may I clearly state that I do *not* think the answer is to welcome the day when the Canadian landscape must be intensely managed in the European style. I well remember a guest speaker at a Vancouver forestry/wildlife conference who eloquently argued for this. Forget wilderness he said, with great excitement and sincerity, "The managed forest is where the action is." He got a standing ovation. But that isn't *my* vision. And I'm proud to say it wasn't Ian McTaggart Cowan's either, who the next day stood up to say maybe we still have other options in Canada. *If* we choose to exercise them. So far we have not and we won't have forever to do so.

I think a second touchstone for the future of large carnivores is whether or not this tide of large-scale predator control can itself be controlled. I know this is a controversial issue, with very defendable arguments on all sides, but professionally speaking I just don't agree with it. In almost every case, I don't think we know what we're doing when we make such large scale interventions into natural systems. We remove 80% of the wolves from an area to increase ungulate populations, just begging for a compensatory backlash because of wolves' demonstrated reproductive capability under such situations. The result - probably *more* wolves in the long run. Let's face it. Wolf control programs are entirely short term in their perspective and results, based on short term research, and usually in response to short term political pressure.

On the other end of the scale, we have stepped up grizzly hunting and trapping, say to improve survival of moose calves. Again, I must ask, do we know what we are doing? In this case we're whacking into a population with a *low* reproductive capability - the females take a long time to reach reproductive age, they have few young, often at relatively long intervals. This has led to some ridiculous situations. For example, at least one jurisdiction has approached World Wildlife Fund to help translocate bears from areas where the level of predation by bears is judged to be politically unacceptable, to other areas where they are too scarce because they were removed earlier in response to pressure for control measures. Do you follow me? It's a self-feeding argument which poses the image of "musical bears", animals being moved into successive black holes created by previous removal efforts. All of this, in the face of scientific literature which indicates that translocation of large carnivores on balance has been a pretty unsuccessful undertaking. If you think I'm oversimplifying, or being unfair, I challenge anyone here to imagine yourself chairing a public meeting, trying to defend such a policy, and putting it to the test of common sense. Good luck.

Even if large scale predator control *could* be carried out with scientific predictability, I think it poses serious ethical problems. And on this basis, again there is every indication that public opinion is strongly against such programs. As he so often did, Pimlott also foresaw this issue clearly and focused the question for us:

> "The greatest danger to timber wolves lies in the future - in the latter part of this century - when large areas of big-game range are no longer accessible, when the annual kill has finally approached the production of their herds. What will our attitude be then? Will we be willing to share deer, moose and caribou with the wolves?"

Many jurisdictions in Canada have already said no to Pimlott. We will not share. I suspect the other jurisdictions are thinking about it, frankly, waiting to see how the others fare in terms of public opinion.

Third, and finally, I believe a test for the future of large carnivores lies in the funds being committed for research. The record shows that it's always more difficult to argue for the benefits of conserving species when you don't know much about them. Particularly when the cash values of logging, mining, or otherwise developing an area can be so persuasively defined. I think I can raise this question with some legitimacy, because I'm told that in many cases World Wildlife Fund has become the *last* source of funding for long-term studies on large carnivores in Canada. If this is true, I think it's a bloody shame, because I'm personally acquainted with how little we have to spend in this regard.

Yet I'm proposing this evening that World Wildlife Fund Canada get even *more* rather than less involved in the issues I've just outlined. Specifically, I think we should suggest the elements of a national conservation strategy which would ensure a future for Canada's large carnivores. This would include reviewing the three points I've raised this evening, namely:

1. The identification and protection of wilderness areas large enough to sustain wild carnivores,
2. Policies on large scale predator control programs, and
3. The commitment to research, especially for conservation purposes.

I think I would want to include a fourth point, namely: the basis upon which levels of harvest are set for both commercial and sport hunting purposes, and the extent to which they are monitored in conjunction with other human causes of mortality such as defence kills. In other words, do we know with reasonable confidence how many animals are being removed from the Canadian population annually by people, and is this number within safe conservation limits? I believe this has already become critical information with respect to polar bears and grizzlies, and there has been recent concern expressed even about black bears in jurisdictions such as Ontario. The eastern cougar of course, if it still exists, is already an endangered species; and the wolf, although it is still abundant in Canada, has been extirpated from most of its former range in Europe and the mainland United States.

Having prepared such a strategy, and through it having stated what is needed, we would then compare existing policies in these areas to assess whether or not they add up to something which can do the job.

*Some*one has got to do it.

Otherwise, I think we will simply continue to lose by default until we pass a threshold beyond which we no longer *have* the option to sustain self-regulating populations of large carnivores in the wild. I would appreciate ideas and input from anyone at this meeting as to whether you think it's worth doing, how general or specific such a strategy would have to be to be useful, and most important, whether you are interested in helping. We sure can't do it without you.

Let me sum up, because I've kept you a long time, and I've tried to speak seriously at a moment in your conference when you probably needed something quite different.

I'll close with a confession. I composed the thoughts for this talk during a spring snowshoe trip into Doug

Pimlott's cabin. He was a close friend. I gave the eulogy at his memorial service in 1978 on what happened to be the same day I took this job at World Wildlife Fund. Doug was also a realist. A hard-nosed scientist, not a teary-eyed "condominium conservationist". I'm not exactly an apologist for the animal rights movement myself, and if anything have been criticized for not being more sympathetic to their cause. Therefore, I hope my remarks this evening won't be misinterpreted. I'm not suggesting everyone should break down and cry when the occasional marauding bear or sheep-eating wolf is killed. I'm not talking about that. I'm talking about the vision I referred to earlier. I'm talking about fundamental choices regarding what we want *around* on this planet fifty or a hundred years from now.

Leopold spoke of what he wanted for his sons and daughters. Pimlott said he hoped his grandchildren, and theirs, would know a world in which people accepted large carnivores as "desirable members of the total community". I'm sure you want the same for your children. I've already taught my six-year-old son, Douglas, how to howl for wolves, and I hope he teaches his kids. I also hope they can go out with Ian Stirling's protegés to observe polar bears. With your help, maybe there will be something out there to howl and growl back when they go looking.

PANEL DISCUSSION I

Panel discussions were summarized from verbatim transcripts of tapes.

INTERJURISDICTIONAL PROBLEM BEAR MANAGEMENT: CAN IT WORK?

CHAIRMAN: JOHN WARD, Dome Petroleum, Calgary, Alberta

PANEL MEMBERS: RICHARD LEONARD, Canadian Parks Service, Winnipeg, Manitoba
MARY MEAGHER, U.S. National Park Service, Yellowstone National Park, Wyoming
BARNEY SMITH, Yukon Department of Renewable Resources, Whitehorse, Yukon
CHRIS SERVHEEN, U.S. Fish and Wildlife Service, Missoula, Montana

Subject of Discussion: Problem bear management usually involves several jurisdictions and agencies. To effectively manage problem bears, open lines of communication and coordinated management plans are often required. This panel will address the problems, concerns, challenges, and successes of interjurisdictional management.

SUMMARY OF MAJOR POINTS PRESENTED BY PANEL MEMBERS

U.S. Experience

- There are 7 National Parks, including Yellowstone and Glacier, which have "exclusive jurisdiction". This means that everything within the boundaries of the park is the basic jurisdiction of the National Park Service. Consequently, for many years there was little communication or cooperation between Yellowstone and the agencies with responsibilities for surrounding land. However, changes over time, such as a decrease in grizzly bear habitat in the Rocky Mountains and a greater public concern for grizzlies as a rare species have led to changes in Yellowstone's way of operating. Despite the "state versus federal" undercurrent - which is long-standing and may never entirely disappear - interagency cooperation has improved greatly even in the last 5 or 6 years.

- There are several ways to bridge interagency differences:

    - Professional relationships between individuals are fundamental - if individuals want to make it work, they can.

    - Sharing the biological data base creates a good working base among agencies.

    - Ongoing communication is essential. Yellowstone has a fairly formal communication system as it is the centre for the bear monitoring program. But ultimately, it is biologists, wardens, and rangers talking to each other that builds the bridges within the formal structure.

- Because the grizzly bear has been considered a threatened species in the lower 48 states since 1975, the federal government has got involved in the management of what was once a state game animal. The Interagency Grizzly Bear Committee deals with grizzly bear management. The grizzly's range is 6 different isolated populations in 4 states. The management goal is to establish viable populations in those areas. The habitat is defined in terms of recovery zones, within which bears are managed, and outside of which bears may occur but are not managed. Three "Management Situations" specify how the habitat and the bears will be managed at different levels of intensity. The Interagency Grizzly Bear Guidelines explain the details for management in each situation. The detail and protocol involved are very complex, have taken a long time to work out, and are very usefully.

- Nine federal and state agencies, 2 Indian tribes, and numerous local organizations (towns, communities, refuse disposal districts) deal with grizzly bears in the lower 48 states. The objective is to minimize conflicts, not bears. Management efforts are directed toward finding and minimizing the origin of the conflict, as well as dealing with the bear. The Interagency Grizzly Bear Guidelines detail a strict protocol for dealing with nuisance bears. There is a phone contact list including a decision person from each agency. Bear problems are dealt with through conference calls. An initial call is made, before capture efforts are started, to discuss whether the bear is actually a nuisance bear. If the bear is not considered responsible for the conflict, other action will taken to remove the conflict, such as removing a dirty camp. If it is decided that the bear is a nuisance bear, the responsible agency will proceed with capture efforts. Once the bear is captured, another call is made to decide on further action based on knowledge of the individual bear and the situation. The guidelines specify procedures for dealing with bears with different histories of conflict. They also specify relocation sites, protocol for sharing costs and monitoring efforts, and record-keeping procedures. It takes a lot of work, and a lot of communication and cooperation, to keep this going. There has been a remarkable change in the amount of interagency cooperation which is critical to success as most grizzlies spend their lives in several jurisdictions. Successful cooperation does not just happen. It takes continual effort, with a common goal in mind.

The Canadian Experience

- Most of the Canadian national parks are fairly new, so interjurisdictional bear management is at an early stage. It is important to "get one's own house in order" before dealing with other agencies. Emphasis should be on managing the bear population, rather than nuisance bears, and on correcting internal causes of problems such as food and garbage. Once bear management objectives for a particular park have been analyzed and approved in a management plan, other agencies can be asked for their objectives. Some agencies do not have detailed objectives for bear management, a situation which can lead to interesting discussions, especially if there are several schools of thought regarding bear management within the agency. It may take a long time to sort out objectives.

- It is important for each agency to realize that, although each may have different objectives, both are valid, and some give-and-take is necessary to fulfil them. This takes professionalism and maturity.

- Results of discussions may range from an informal agreement to coordinate handling of nuisance bears to a fairly significant agreement, approved by both agencies, to conduct bear management in a particular way.

- Problems have been experienced:

    - The objectives of the park and those of the agency responsible for land surrounding the park may be so different that a compromise cannot be found.

    - Interagency cooperation can be difficult until both parties develop a mutual trust on a professional basis.

- There have been successes. Parks and one of the provincial governments have developed a memorandum of understanding to look at a cooperative 3-year black bear management program. Both agencies are putting substantial amounts of resources into the study. The benefit of the cooperative approach is that a study can be done which neither agency could do alone.

- In remote areas with small populations, such as the territories, there may not be a great diversity of agencies. Wildlife managers often have to be generalists, with the training, authority, and responsibility to deal with all types of community concerns.

- A fairly recent development in the north is the formation of advisory boards and management boards that allow the public to become involved in decisions about research and management programs. This presents a different kind of challenge, as board members vary considerably in their background and knowledge. Training and education programs are needed to help people make sound decisions.

- It is usually not difficult working with colleagues doing similar work in other agencies, as everyone "speaks the same language" and shares a similar background. It can be more difficult working with a specialist in another area or someone with very different priorities. Then it becomes necessary to sit down and find common ground, to establish a relationship.

- As more and more planners are coming into renewable resources departments, it becomes necessary to take the time to make sure they are well informed about pertinent concerns and issues.

- In the Yukon, where issues tend to be less complex than in the south, informal agreements and working relationships are relied on more than formal ones. Better cooperation among jurisdictions in program evaluation and data collection would make it easier to compare information.

- The greatest success in interagency cooperation is probably the Federal-Provincial Polar Bear Technical Committee and Administrative Committee. It resulted from an International Agreement about the Conservation of Polar Bears. Committee members get together once a year, as colleagues, and it has proven to be a very valuable opportunity to exchange information, informally allocate responsibilities for research, decide how to share funds most efficiently, and coordinate education programs. The committee is developing a more coordinated approach to education, where member agencies produce materials that are audience- and subject-specific, but general in terms of area. This will allow a more efficient use of funds as materials can be used in different areas.

SUMMARY OF DISCUSSION

Q. How does the Polar Bear Technical Committee view involvement by National Parks? Three parks have polar bears, but National Parks has no representation on the committee. It would be helpful especially for coordinating information and education.

A. The committee is flexible enough to accommodate members from other agencies and from universities. It should be able to accommodate the needs described, but the terms of reference would have to be discussed with Ian Stirling (Chairman).

Q. Under what circumstances is a formal agreement required - i.e. something written on paper - and under what circumstances is an informal arrangement more effective?

A. There is no substitute for the informal arrangement in making things work day-to-day. Nevertheless, although they can be frustrating, formal arrangements are necessary to bridge time, i.e. to provide a framework that transcends individual personalities and changes in personnel and involvement over time.

Q. What would be the likelihood of Canada getting federal, provincial, and territorial agencies to cooperate on a national strategy to conserve self-regulating populations of large carnivores, using as a parallel the function of the International Agreement on the Conservation of Polar Bears? Maybe that's where a formal agreement would be useful - in helping people focus on a common goal and work together.

A.
- One of the prime objectives of National Parks is to maintain gene pools of naturally regulated animals, so Parks should certainly support something like that (personal opinion).

- To what extent are self-regulated populations important in the maintenance and conservation of these populations? And is it really necessary to formally set aside areas for naturally regulated populations? There is a clear difference in the responsibilities of territorial/provincial governments and National Parks, given the huge area required to maintain a reserve for naturally regulated populations. It seems unlikely that most provinces would be able to set aside areas that large. Such areas exist in the territories, but given their low levels of use, formal agreements may not be necessary to maintain them. It seems that territorial and provincial governments are committed to the goal of maintaining viable populations of large carnivores - harvest and management problems notwithstanding.

- This has nothing to do with bear management, but is an example of an interagency management process that has developed from an informal to a formal arrangement and worked quite well. In 1983, the Province of Alberta and Parks Canada were working informally on the enhancement and development of the Anatum Peregrine Falcon Fostering Program and pesticide analysis in the area. Recently, a formal document has been developed that outlines responsibilities of the Province of Alberta and Parks Canada in the program, and to a lesser extent Canadian Wildlife Service. The formal agreement has made possible things that probably neither agency could have done alone. Because one agency was able to commit some money, it gave the other groups leverage to obtain a financial commitment. Between the two, now there is enough money for a pretty effective program.

Q. In dealing with people at the local level, e.g. community organizations of users' groups, can you operate on an informal basis or do you need to establish some kind of formal agreement.

A.

- In the NWT, there is an informal working relationship with the Hunters and Trappers Associations regarding polar bears. The local people are included in the decision-making process. Their information base, ideas, and hunting patterns are incorporated, essentially making the people responsible for the resource, because the international agreement specifies that they are the ones who are allowed to take polar bears. This informal arrangement is quite useful.
- In Alaska, there is quite a network of organizations and agencies under various legislative directives that are formalized at state and federal levels and all interact together. This formal arrangement is necessary and serves a good purpose given the complexity of jurisdictions and land uses within the state. It probably would not work as well on an informal level. There are still a lot of problems to overcome, but this arrangement provides a forum for a lot of discussion. It has been a positive step. Federal agencies in Alaska use memoranda of agreement among themselves. These are umbrella agreements that allow a lot of things to get done cooperatively without having to wait two years for every agreement. They have been very helpful in a practical way, especially in dealing with the federal budget process. Sometimes it is difficult to know how much research money will be available. When extra money suddenly becomes available, it may be too late to arrange an outside contract. In such cases, under the agreement, personnel from other agencies may do the work. Without the umbrella agreements with other agencies, the opportunity to do research would be lost when money suddenly becomes available.

Q. Is there a formal memorandum of understanding regarding the Polar Bear Technical Committee, or is it operated on an informal basis?

A. There is a formal structure under which the Federal-Provincial Polar Bear Technical Committee exists. The official committee is to be comprised of one member from each jurisdiction responsible for managing polar bears. These people are to meet once a year to discuss all research on polar bears, and anything that may be applicable to management. Members are to provide managers with the best possible information on polar bears on an annual basis. This is a formal instruction. There is an Administrative Committee made up of the directors of each jurisdiction with management responsibility. The meet once a year to discuss the research and recommendations of the Technical Committee, which they may or may not accept. They may ask the Committee to address certain issues in the next year. The Committee has been expanded to include a whole variety of other people with particular expertise on polar bears - in areas such as modelling, energetics, physiology, behaviour. All these people are included in the meeting to get the best possible discussion and evaluation of research and planning. By direction of the Administrative Committee, if there is ever a vote, only those people who are government employees can vote. However, this has never been exercised. One of the reasons the Technical Committee has been so successful is that is has operated by consensus.

Q. People from the U.S. have been involved in some of these meetings. Is that strictly informal, or is there a formal arrangement?

A. It is semiformal. There are Committee members from the U.S. Fish and Wildlife Service in Alaska who come every year. If there were a vote - which has not happened in 17 years - they would not be allowed to vote.

PANEL DISCUSSION II

Panel discussions were summarized from verbatim transcripts of tapes.

THE FUTURE DIRECTION OF PROBLEM BEAR RESEARCH AND MANAGEMENT

CHAIRMAN: MITCH TAYLOR, Northwest Territories Department of Renewable Resources, Yellowknife

PANEL MEMBERS: STEPHEN KEARNEY, Manitoba Department of Natural Resources, Thompson
PAUL WATTS, Institute of Arctic Ecophysiology, Churchill, Manitoba
JOHN DALLE-MOLLE, Denali National Park, Alaska
WALTER HOWARD, University of California, Davis
IAN STIRLING, Canadian Wildlife Service, Edmonton, Alberta
FRED BUNNELL, University of British Columbia, Vancouver

Subject of Discussion: In the past ten years different agencies have addressed problem bear management. As a result, several management strategies are available and are being implemented. This panel will address present knowledge gaps in problem bear research and management, and make recommendations for future direction.

SUMMARY OF MAJOR POINTS PRESENTED BY PANEL MEMBERS

Major Advances to Date in Problem Bear Research and Management

- Great progress in understanding the ethology of human-bear dynamics.
- Considerable advances in bear deterrent technology and technology to isolate anthropogenic food sources from bears.
- Development of effective educational materials tailored for specific audiences.
- Better rules for managing public lands.
- Appreciation for the critical role that bear deterrent work is going to play in the long-term conservation of species that have considerable interactions with humans.

Current "Knowledge Gaps" and Concerns

- What are the long-term effective deterrent techniques on bear populations - i.e., what will happen if bears start to be excluded from good habitat as a policy to minimize human-bear conflicts. Will deterrence or destruction of bears for control purposes eventually result in the extinction of bears from areas where they exist currently only in remnant populations?
- There is a need for further development of deterrent techniques that can be used in the back-country - with or without firearms - that would reduce the number of bears that have to be shot as problem animals.
- The questions are endless regarding the effects of consumptive use, non-consumptive use, and harassment on polar bears, especially in the Churchill area. At what point does non-consumptive use become harassment? Now people are going to the bears - into the fall staging areas and into the maternity denning areas. Will this affect population dynamics, movements, behaviour? What is the relationship between public viewing of bears and habituation of bears in different situations?
- Regarding the effects of food on human-bear encounters, there seems to be conflicting evidence among different populations. It may be helpful to take a closer look at the actual food requirements of individual species and then apply it to populations, e.g. look at the energy costs associated with free-living and the gain from particular food sources.

Models of bioenergetic need would be especially helpful in interpreting a lot of the conflicting information.

- How do we get political jurisdictions to accept some of the known solutions?
- Continued work on population indexing and trend monitoring is needed. The public gets very confused - for example in Yellowstone; they hear a lot of figures thrown around. After all the years of work and all the expense, biologists still cannot answer the questions "how many animals are there?" or "what is the trend?". It is hard to build strong grassroots support without some basic numbers to give the public with some confidence.
- Long-range habitat changes are an area of concern. What is being done in terms of management to ensure that the habitat in protected areas remains grizzly habitat? Succession will ultimately hurt the bear populations. Consideration should be given to fire management programs.
- It is apparent that bears of the same species differ greatly in their behaviour from one place to another. More work is needed on the behaviour and aggressiveness of bear populations in different areas, so that management can be based on area-specific knowledge rather than on generalizations across populations.
- What are the self-regulating factors that exist in populations? What is the sustainable yield of barren ground grizzly bears? It may be necessary to take risks to learn the answers, e.g. artificial perturbations of barren ground grizzly bears in remote areas in cooperation with Hunters and Trappers Associations.
- Specifics: What does happen to relocated bears? What is going on with aggression and habitat segregation? What is going on with the sex ratio in litters?
- What are the implications of development-related habitat modifications? For instance, offshore oil rigs and artificial islands can create open leads in the ice, which concentrate seals, which attract polar bears. So although people are not actively feeding bears, positive reinforcement is occurring. This certainly has implications for bear detection and deterrence.
- What is wanted by whom in bear management? What are people willing to accommodate for wilderness? How much wilderness and in what circumstances? Are people willing to accept camping inside a compound in a national park to prevent bears from getting food and to ensure the safety of the people? These types of issues should be addressed.

Recommendations For Future Directions in Research and Management

- There should be continued effort to ensure that advances in technology and understanding of behaviour are incorporated as policy. It may be necessary to get into the political fray.
- The application of what is currently known is most important. There has not been enough time to understand it all. Passive or reflective research would be of enormous value - synthesizing all the material that has been presented at this gathering. Scientists have a responsibility collectively to make use of the results of research, of what is in the notebooks, to get the information out. It is also important to look beyond the obvious, to try to understand the underlying scientific basis of results.
- "Problem bear management" is an inappropriate way of referring to bear-people programs now, as it has been shown here that poor planning, poor people management, poor education programs, etc. are often as much a problem as the bears are. The whole subject should be a part of bear management.
- The need for education is obvious; education is the key. The public has an insatiable desire to see and learn more about most of the large carnivores. A lot more information about bears can be provided to the public. In a lot of ways they are a more important audience than other scientists. More effort could be directed toward researching the needs and attitudes of specific audiences and the best ways of presenting information to them.
- Bear-people management problems should be applied to larger areas.
- It would be useful to integrate bear deterrent work with other areas of science. Understanding the basic physiology of the animal can provide a lot of useful information. For example, some fairly

sophisticated physiological work on polar bears showed that many of the bears feeding at the Churchill dump did not require that food source. They can live without food or water for extended periods. The practical management implication is that bears can be removed from the dump and held until freeze-up without being fed, so the risk of positive conditioning is avoided.

- Actively involve user groups in collecting information and in formulating policies.

- Get more involved in habitat protection - i.e., not simply habitat enhancement, but trying to get more habitat actually put into categories that would protect bears.

- Put more effort into building grassroots support for management, including habitat protection and bear-people management programs. There is no question there will be less habitat available in the future. Without grassroots support, management will ultimately fail.

- Research should continue on aversive conditioning as an alternative to removing bears from populations, and on learning, habituation, and psychology of bears in general.

- Adaptive management is valuable when it can be done. Treat management as an experiment. Predict the outcome of the management action before it is started, as though it were research, and then monitor and evaluate the results. Learn from management actions.

- Increased recognition should be given to the three phases of applied research: research, development, and application. Research is creating something new. Development is making simple, practical, usable tools out of the findings of research. Application involves someone with the right connections and the understanding of the politics and the logistics to get the results into place. This implies the need to work in teams and do inter-jurisdictional research. It is also important to recognize the three parts of applied research: the manager, who has simple indices and simple tools; the researcher, who examines the interrelationships that underlie the indices; and the middle part, the connection between the two. The middle part has often been forgotten, but hopefully will start to connect in the future.

- The knowledge and statistical abilities exist to allow more complex experiments. There is a need for more critical hypothesis testing. And it may be necessary to start looking at combined indices, i.e., combinations of relationships that indicate the health of a bear population.

- More long-term work is needed - following a number of individual bears through time. It can be done at a low level of cost.

SUMMARY OF MAJOR POINTS OF DISCUSSION

- There seemed to be a paradigm put forward that a bear that comes into repeated contact with humans becomes habituated, and becomes a problem bear, and that problem bears do not contribute significantly to the population growth rate. They are essentially removed from the gene pool. That suggests that more work is needed on managing problem bears. Northern populations can afford to lose a few females, but what is the effect on remnant populations, for instance, of removing females that frequent dumps? If a population can only afford to lose 4 or 5 adult females in a year, there should be some concern about the long-term effects of that paradigm.

- The pros and cons of providing opportunities for the public to view bears:

    - Closing all the dumps is essentially removing most opportunities for the public to view bears. Public appreciation is critical to long-term support of bear research and conservation. One direction for research is to come up with more inexpensive ways of providing opportunities for the public to watch and photograph bears.

        - There are a number of areas where that could represent a significant source of income for local people who might be interested in developing such opportunities.

        - Bears are basically secretive by nature and were never meant to be studied or photographed at close range. Bio-political stress is causing these reactions among scientists and politicians. It should not be a management consideration.

- There are a number of situations where people can observe animals without disrupting or disturbing them. There are probably situations in the Canadian north where people can observe polar bears at a distance without the bears ever being aware that they are present. If people are going to have an impact on the animals, then it is unacceptable.

- There is a need to move quickly to establish safe public viewing areas. There are numerous potential areas where bears can be watched in natural environments. They are not being capitalized on because the grizzly has a public image of a dangerous animal that threatens every hiker who goes into the back-country.

RAPPORTEUR'S REPORT

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When Paul called and asked me to be rapporteur, I asked him - why me? Paul was evasive, but I finally realized he thought I had the 3 qualifications of a good rapporteur. First, grey hair for the mature look. Second, glasses for the wise look. Third, hemorrhoids for the concerned look. I am only batting 2 out of 3, but I will try anyhow. We were presented with a great deal of new information at this gathering. Once again I learned a lot from my co-workers. We heard a lot of potential advice - how to do things. You probably can't follow all of that advice. In fact, there would be chaos if you tried to follow all of it at any one place. They have known that since biblical times. You know the ancient story. There is an old, old man in the Holy Land. He is struggling along, trudging along, barefoot down a road, the rocks are sharp, the road is dusty, and he has cut his feet. Beside him is a young boy in torn sandals, and the rocks are cutting his feet too. Ambling behind is a healthy donkey. They are trudging along when they meet a group of travellers. The travellers say "look at that poor old man with his bleeding feet and that fat indolent donkey." So the old man shrugged, he took their advice, and he climbed on board. It was not very long before they ran into a second group of travellers. These said "for shame, a grown man riding a donkey and look at that poor little boy with his bleeding feet." So the old man shrugged, he took this new advice, and put the boy in his place. It was not much later when they met another group of travellers. These people had still more advice to give; they said "that healthy donkey carrying only that boy, surely it could carry them both." The old man took their advice, he climbed on with the boy. Came the rickety bridge over a fast-flowing stream. The now tired donkey starts across. He gets halfway across when the bridge collapses under the combined weight. All three - man, boy, and donkey - fall into the raging torrent. Man and boy were rested, they made it to shore. The donkey was weary, over-burdened, and he got washed down stream. Wasted. That parable proves one thing: if you take advice from everyone, you will lose your ass.

Now, don't blame me for the language, that's the way they spoke in biblical times. What I want to do is go through the individual sessions and summarize some of the points that struck me as being important. Maybe I'll have move advice. Remember the parable. I will treat the sessions in order, despite the fact that they are interrelated.

The first session was behaviour and ecology of problem bears. Although the session exposed several problems, I thought it also offered some really excellent promise. Generally if an animal does something we call it instinct. If a person does the *same* thing for the *same* reason we call it intelligence. The session called it behaviour. Barrie Gilbert and Steve Herrero, because of their histories, stress the intelligence of the critter, and all my experience tells me to believe them. But this intelligence is a 2-edged sword. It gives bears the opportunity to avoid the consequences of some of our mistakes, but it also makes it more difficult for us to manage them effectively. Some things are simply baffling. How do those bears that Chris Dau was talking about know when - because they do it at the right time - when to swim 10 miles to an island to get sea bird eggs? I find it baffling. Some things are simply confusing. How do you respond when each individual bear has its own personal history and is exploiting its own personal strategy? How do you respond as a manager? And some actions are merely going to introduce enough variability to maintain differences of opinion between different researchers and different managers. Dave Garshelis finds black bears leaving dumps, once the natural foods recover. Mary Meagher, watching the situation at Yellowstone, wonders if maybe it is just 1-time training and then bears are addicted. The variability that intelligence introduces is wonderful. Generally, I suspect that the bears' intelligence always has complicated and will continue to complicate our management efforts. Given that complication and confusion, the first important point I want to make is that in any research or management effort, if at first you succeed, hide your astonishment.

There are actually 4 points I want to draw from the first session. One is the implication of the bears' intelligence and learning abilities. Now if a rufus hummingbird, which weighs 2 dimes, can build a map on its forehead of the location of its food stuffs, and use that map to keep finding those food stuffs, we should not be surprised at what a grizzly can do. Steve and Barrie both used phrases which summarized the implications really well. Steve said "manmade bears through learning". Barrie said "the bear is learning at every contact ... we could train them just like journalists." Many papers in the session emphasized those points and the bears' ability to learn. That ability stresses the need for continued diligence, we cannot make too many mistakes. The ability also exposes the possibilities of aversive conditioning and habituation, which we also can exploit. But coupled with the bears' memories, the learning ability illustrates that our mistakes can be around for a long, long time. The intelligence gives David Graber and others nightmares, when they wonder how long is it going to take the bears to figure out the food has got to come down from the cable or it has got to come down from the pole.

These observations lead to habituation, my second point, which also is a 2-edged sword. With predictable patterns, by controlling human movements in a predictable fashion, we can bring the bears and people close together. We can provide the viewing opportunities that I believe are going to be very important in maintaining public support for the bear. There were a number of examples given in this symposium; Barrie's of Brooks was probably the most dramatic. *But*, there is also evidence that habituated bears are more likely to create problems. The sword. These latter examples ranged from Steve Herrero's initial summary - 12 out of 12 man-killing bears were habituated. Erik Nyholm's observation of more problems in areas of Finland where the hunting was closed so there was possibly no aversive conditioning. Bruce McLellan finds the things in the Flathead. Steve Nadeau's observation that the chances of injury are greater in areas of low use. Ole Sorenson argued that hunting has created "ghost" bears - and Ole believes these ghosts are real. It is going to go both ways, the habituation could cause problems for us or we could exploit it. And that leads to my third point for the first session: the importance of human attitudes. This point also was repeated throughout the symposium. The issue I want to draw out here is from the first session. It was a point Chris Dau raised, and that was one instant - one casualty - at Cold Bay changed the public attitude from one of conservation to one of more consumptive use. Together these observations suggest to me that in this exploitation of habituation, we have a tiger by the tail; if we let go of the tail we are buggared. A mistake could have far more consequences than a single human life. Public attitudes are both important and fickle.

My fourth and last point for the first session is a kind of summary. Together the key roles of conditioning and habituation suggest that we must get a firmer handle on them. We have a trick that we are trying to perform: in some areas we are exploiting habituation to predictable human patterns so we can bring man and bear close together; in other areas we are exploiting conditioning and habituation to keep man and bear apart. Whatever the result is we have got to understand it; we've got the tiger by the tail. One of the pleasant surprises to me is that we are ready to perform the trick. First, there is now a really impressive collection of documented examples. I think that is going to be one of the major contributions of this symposium. Second Barrie Gilbert provided a conceptual framework in his talk, incorporating elements of history, habitat quality, and population consequences. We now have the data and the framework. We can proceed with analysis. The time is ripe for a useful synthesis and evaluation. If you consider the papers given we are also accumulating impressive amounts of information that should allow more confident prediction of the consequences to bears, perhaps through displacement of particular human activities; or prediction of consequences of shifting bears to other habitats, or prediction of the probability of human injury. I believe there are really important opportunities for synthesis.

The second session was on bear detection and deterrent techniques. In Paul Gray's review of detection he noted the diverse variables - habitat, bear experience, people experience, cost etc. - and he stated that individual solutions are going to require some imagination. The session demonstrated that imagination. I heard about a lot more than I imagined hearing about - from Turkish Akbash dogs to good star-war lasers. If Chuck Jonkel had been here then I would have heard about pepper on the nose and other good chemicals. Naturally we considered the eminently practical deterrent, 12-gauge shotgun. It wasn't possible to treat in detail all the advantages and disadvantages of those different approaches. I remember Paul saying one advantage of the little trip-wire doodad was that you could keep it in your sleeping bag. Well the first damn thing that occurred to me was he missed a key point: I thought O.K., you're out there alone, it's 3 AM, you're in polar bear country, may be it's even dark. An alarm goes off in your ear. Paul didn't mention the subsequent condition of the sleeping bag.

There are 3 points I want to draw out of the second session. First, is the diversity of potential approaches being considered, from capsicum to lasers. Fear is the real mother of invention. It ends up inspiring Chris Davies to develop an electric fence that appears to work. We heard about Bill Carpenter's, and Jeff Green's, work on developing and refining approaches with dogs that are at least a millennium old. I haven't a clue how old Erik Nyholm's Finnish bear lance is. Second, we are accumulating knowledge on the role of behaviour and natural history in detection and deterrence. There were all kinds of examples: Rich Leonard pointing out that 73% of the bear-human contacts occurred within a 1 month period; Steve Nadeau's observations that the bears' use was responding to the phenology of the forage; Chris Davies' notions that the electric fence was exploiting learning, because the bear was associating the feeling across his chest with the shock. So we have a great variety of approaches and we are learning how bear behaviour and natural history interact with these approaches. We are learning how to exploit the bears' ability to learn. This accumulation of knowledge permits my third point.

We are beginning to get a lot more practical about bear-people conflicts. Ron Hanson was the first to mention the issue explicitly with his comments on the structuring and delegating of responsibilities when a situation is clearly dangerous and requires haste. But the issue of practicality and simplicity was raised throughout the symposium. I like the simplicity of some of the notions, like Davies' electric fence, and the food containers. So I was satisfied, despite the missing papers on aversive conditioning and chemical repellents. It seems there is plenty of imagination and plenty of ingenuity, so we have got a growing edge on management. We also have a growing awareness of the complexities of the bears' behaviour. But we are learning how to use that complexity, learning how to exploit the bears' learning abilities to save people and bears. So I was satisfied with the session. I remember Ron Hanson's response to, I guess it was both Barrie and Steve asked him, "do you guys work at acquiring data on a man-bear incident, about why it happened, or do you just try and mop up the bear as quickly as possible?" And Ron said "Yeah, we try to understand". That is great. As long as we keep pursuing why, even under difficult conditions, and as long as we are inventing practical approaches and fairly simple solutions to some issues, we have got a recipe for success.

When I think about the third session, problem bear management programs, which Ian Stirling chaired so admirably, there are 5 points I want to draw out. First, an impressive amount seems to be learned, or if it was not learned at least working hypotheses were erected, by judicious or fortuitous combinations of research with management. Ian and Steve Kearney out of Churchill; Dave Garshelis erecting and then destroying his hypothesis; Garner and Vaughan summarizing the happenings in Virginia; or John Dalle-Molle and crew in Denali reviewing past events. On the panel I told you I was an advocate of adaptive management: treating what you were doing as an experiment, even when it's a management action, predicting the consequences, and monitoring. You learn from that sequence and it gives you a growing edge to your management. I think many groups here have got that growing edge - keep it.

My second point is that there is a really impressive tool kit being tried. Sure some of the techniques were site-specific or species-specific. I think caging polar bears is not going to work everywhere. But some techniques are not specific, and the striking point in my head is the array. We have got a variety of deterrents, we have got a bunch of people and places trying to sharpen policy as a tool - whether it is Wayne McCrory talking about British Columbia, Erich Follmann talking about site planning in Alaska, in Denali, in Manitoba, - it is going on. We have got a variety of food storage containers. We have got hunting seasons on the critter itself. We have got hunting seasons on other critters - like Vic Barnes' story of deer on Kodiak Island. We have surcharges for defraying costs, closed areas, bear monitors - there is just a huge array. That is a complex tool kit. The kit is available. And the tools got shared. It even appears that maybe we can start working towards distant early warning systems when we start to sort out the role of phenology. The comments that Steve Nadeau made, or Gary Vequist, or Dave Garshelis, about the responses to key forage species and to phenology are promising. Maybe we can predict when we are going to have problems, once we tighten up these notions. I think that is great - as long as we keep monitoring, we are going to keep learning a lot. And then synthesis, something I mentioned on the panel. I want to return to that again, because this gathering exposed an amazing collection of observations. This is my third point - the opportunities for synthesis. Many observations were not consistent; consider just the sex and age of problem bears. Steve Nadeau mentioned that it was subadults close to camp that were problem or potential problem animals. Dave Graber said it was the young males and sometimes older females. Steve Kearney says it is subadults, and then sometimes females with young return and become pets. Erik Nyholm says it is adult males that are the problem in Finland. Chris Dau says that there is circumstantial evidence that adult males are avoiding humans. We encounter the variability again, that will always be present among intelligent critters. But we also have possibilities to synthesize this variability. In some cases the probable reasons for the disparities or differences are clear. Churchill is an example, where management and research have been closely linked. Other differences we can sort out if we start to erect a conceptual framework, similar to what Barrie Gilbert put together on habituation, to start to predict the likelihood of problems arising and which sex and age class is going to be involved. Maybe our variables are things like habitat quality, sex ratio in the population, and harvest intensity. We now have enough data that we can start examining these questions; many issues appear ripe for synthesis. Science and management leap-frog, we can exploit that. We go from art to science, and it happened throughout the session as well as in other parts of the symposium. One example was Mary Meagher's presentation, which in my head was really important, because I think it is critical for us to have the fate of those Yellowstone bears and their offspring assembled and available. Susan Fleck sifting through, what was it, 350 polar bear - human interactions. Garner and Vaughan in Virginia, or Hygnstrom and Hauge in Wisconsin, were pulling details together into bigger pieces, giving us a broader picture. Now we are almost ready to just pull out a few smaller , but general, pieces - mechanisms - and I think we are going to learn a lot from that.

My fourth point is a small one that might be important. For one thing, it surprised me. We heard people from parks that are scattered across the continent tell us that they would like to encourage people to be more aggressive towards bears in their park. But they were afraid of the litigation. Well, I have news to share. Steve Herrero told me last night that we do not have to be as much afraid of litigation as we used to be. Lawyers are involved in different activities, they are replacing white rats. They have a new job in the laboratories. There are good reasons. For one thing they are more numerous, for another there are some things a rat won't do, and third, you can develop sympathy for a rat. Actually, litigation will still be with us. One thing I wonder about - is there a role for IBA. Could some small brochure be produced by researchers that would allow parks people to say "here, this is not us saying this, but some tame researcher thinks you should be a little more aggressive."

My last point on this session is the importance of education. If there was a consistent thread, along with the ubiquity of the conditioning and the habituation, it was the importance of education and informing people. The range of contexts was again diverse. It was not simply recreation, it was not simply bear hunters, and not simply guys in industrial sites. Barney Smith talked to us about educating town planners. Vic Barnes talked about deer hunters. And then there was brother Howdie (Walter Howard). Where is Howdie, there is Howdie. I am not going to attack the evangel of death, hell it's his birthday. Besides he is older than I am, greyer, wears glasses and with a grin like that he can't have hemorrhoids either. But it is not my gentlemanly nature that restrains me, it is because I agree with some of what he said. In terms of education, I am just going to phrase it a little differently. First of all the protest industry is important, we have to watch it, and we have to learn to use the media to deal with it. Secondly, we are often too passive, we can demand equal time, and we should. And thirdly, some times we have overprotected; in my experience it usually has been with carnivores. Mary's example in Yellowstone suggests, hey, maybe we should be rethinking that one. Perhaps we should have eliminated dump bears when we closed the dumps. But the point that I think Howdie was on about, was overprotection. We are still going to have to protect sometimes; I have no doubt about that.

The theme of the last session, I agree with Steve, it really was communication. I think it is an incredibly important theme, and not simply because I work as an educator attempting to communicate. It is not because BBC has gone world-wide on a quote about Sasquatch that I wish I never made, nor because I have been honoured with quote of the week and quote of the day - 2 successive days - in the Globe and Mail. Each time this communication was related to bears. My belief in the importance of communication grows from none of that experience, or not much. It grows from my experience with resource management agencies in a number of countries. Always, public education and information has been very important. It is not just safety - a major theme of this symposium - but also the importance of not wasting bears and the dangers of salami tactics. You all must have encountered salami tactics. Vic Barnes' talk reminded me that they are ubiquitous, and simple. If you want a chap's salami it is poor tactics to ask for all of it at once, but you will be surprised how much you can get if you only ask for a small slice at a time. Bears suffer from salami tactics because we often waste them just a bit at a time. Those comments are general, I want to emphasize a few points speakers made in the last session.

First, I believe Ed Struzik's advice was right on. Do not be passive; overcome the aversive conditioning. You too may make quote of the week. If you don't talk to journalists they will find someone else who will. You can complain when misquoted and demand - it is your right - equal time with relevant information. If worried about editing, you can foil video. Simply, pick your nose, pull your ear, or twitch enough that if they edit the interview it looks like the Keystone Cops. If that bothers your sense of decorum, you often can find print journalists who are considerate enough to read controversial items back to you before printing. Whatever your tactics, don't be passive.

Second, I agree with Dave Graber and Joe Nava - journalists are trainable, if we understand their problems and cooperate. You can develop mutually helpful relationships. Try it, it is effective. Joe Nava and Barney Smith talked about specific audiences. Casey Stengel summarized it with his usual eloquence - if you don't know who you're talking to they might not hear you. I think an important point is that the better we inform people, the less we need try to control them.

Third, I like the approach that Paul Watts mentioned: reciprocal education between researcher and user, such as HTA's or the travel industry. There are a lot of people out there who have a lot to teach us, even if it is only the diversity of perceptions. Most often it is more than that.

Lastly, I want to compliment the Yukon and Northwest Territorial governments on their approach to information and education. We live in a media blitz and receive information in 5- to 15-second pieces. When the National news promises us an in-depth report, they usually mean 30 to 40 seconds of material. The territorial governments have taken a far more active approach than I have seen in the south. The approach is also imaginative - everything from recipes to comic books. Imagination is essential in the media blitz. Usually, we know the message we want to communicate. Now we have to pay attention to things most of us have not thought much about: "readability", effective design, and graphics.

I have some final and more general observations on this symposium. First, this meeting has been one of the most informative and important ones I have been to in a long time. I certainly agree with Ian's comments, when he introduced his session, that there is a sense of maturity that has developed in the world of problem bears. Second, it is a good idea to learn from other peoples' mistakes, because you'll never have time to make them all yourself. I found this gathering to be a very important opportunity for sharing mistakes and successes. Let me quote Piet Hein:

> The road to wisdom? well it's plain
> and simple to express
> err
> and err
> and err again
> but less
> and less
> and less.

Third, at least one thing is certain. You do not stumble on anything sitting down. One of the things that impressed me about this meeting was the variety of innovative approaches being tried. I am delighted with the variety. Err, and err, and err again. We have a growing edge on management and can keep it. If we couple the variety of management efforts with monitoring or research we will keep learning. The variety also gives us great opportunities for synthesis and analysis.

Fourth, to some extent Howdie was playing with us - you do not have to be "anti" to be effective. You can play the "anti" games. Jack Ward Thomas has described a bunch of them. "Stand aside and throw rocks" is one; you do not enter the fray, but offer aloof criticism instead. It is safer, but not helpful. "Precision" is another. Researchers are good at precision; they and other folk sometimes call this one "we don't know enough." You can sometimes find good precision players out there measuring with micrometers while the big yellow machines rearrange the world. There is "hog-tied". You can rope them up with legislation so the suckers cannot move. But the opponents have some good games too; "loophole", for example. It's a nice one. You find a legal opening big enough to drive a D-8 through and carry on. In this game it's not what is right that is important, but what is legal. Then there is "we don't do that anymore." When caught, you look sufficiently contrite and acknowledge your predecessor's fault. It works well with dull or reasonably optimistic biologists. One of the best is "whoops" - caught again, you simply yell "whoops, did we do that, awfully sorry." Now in the old days you can see how it was played. Researchers slow things down with an astute game of precision. Opponent slips through with a well-played loophole. Researcher or manager counters with a hogtied, got you now you son of.. whoops, and she's over. We do not have to be "anti", we do not have to do it that way, we do not need to do it that way. Cooperative approaches can be developed. We need new heroes, not the old, wiley whoops player. We need people who have the ingenuity and philosophy to develop and maintain cooperative approaches.

I have a final observation. It isn't profound. Piet Hein said it: problems worthy of attack, prove their worth by hitting back. Bear-people conflicts are problems worthy of attack. They are going to hit back, so my closing statements are these. If everything looks like it's coming your way, you are probably in the wrong lane. Reevaluate. The postman wouldn't deliver any mail if he stopped for every barking dog. Keep on keeping on. And lastly, if they are biting you in the ass, you know you're out in front. Stay there. Thank you.

WORKSHOP I · PROBLEM BEAR MANAGEMENT POLICY AND PLANNING

COMPILED AND EDITED BY: Paul A. Gray

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Paul Gray

Although considerable time and effort is directed into policy development by industry and government, few of us have an opportunity to participate in its development. Policy is a critical component of any management program. It controls the direction and scope of our bear management and research programs, and influences budgets.

The Government of the Northwest Territories defines policy as "commitment to the public to follow an action or course of action in pursuit of approved objectives". Government, and in some cases industry, is accountable to the public. Policy development is a mechanism to address these needs by:

1. Directing action to achieve objectives.
2. Defining overall direction and providing a framework within which decisions can be made.
3. Increasing awareness and promoting accountability.

Policies establish a consistency of purpose applicable in a wide variety of situations, and eliminate ad hoc decisions and decisions based on expediency. In the Northwest Territories, we strive to develop policy for those programs or issues which:

1. Are significant.
2. Require managerial decisions.
3. Are relatively long-term.
4. Affect or are of interest to the public.

Some important considerations to keep in mind when involved in the development of policy include:

1. It should, if possible, be created under the auspices of supporting legislation and the goals and objectives of a strategic plan.
2. It must be realistic.
3. It must be supported with appropriate funding.
4. It must be supported by senior management and technical staff.

A number of delegates have kindly prepared some examples of policy presently being developed or sponsored by their agency. The goal of this workshop will be to focus our discussion around some of these examples and to develop a series of recommendations.

Susan Bonnyman

The Government of the Northwest Territories is presently developing a number of wildlife policies in order to eliminate ad hoc decision-making, and to standardize the implementation of numerous programs. A policy working group has been established within the Wildlife Management Division to oversee the development of these policies.

One example of a policy presently being developed is the orphaned bear cub policy. The policy will guide decisions concerning euthanasia, zoo transplants, research, and the return of cubs back to their natural environment. Euthanasia may be an option in some cases because of regional cultural biases. For example, some of the native people subscribe to the philosophy that it is better to die than to spend a lifetime in a zoo.

The Government of the Northwest Territories is striving to develop standards to ensure proper care of zoo bears, particularly as they relate to daily care and containment facilities (e.g., heat stress). We are presently confronted with the question of whether or not sows will be intentionally harvested if the Government of the Northwest Territories allows cubs to be sold to zoos. One option is to include the commercial disposition of cubs in the annual community quotas. To eliminate individual incentive to harvest sows, the funds generated from the sale of a cub could be directed away from the community to the Regional Hunters and Trappers Association or the General Revenue Fund of the Government of the Northwest Territories. In addition, the policy will contain an updated appendix containing a list of all facilities capable of holding orphaned polar bear cubs.

Stephen Kearney

Within Manitoba, on some occasions attempts have been made to introduce cubs orphaned at a young age (March/April) to other family groups in the area. However, finding another suitable family group in a relatively short time frame is not always possible. This would be the preferred course of action in Manitoba but its level of success or failure is not known.

On another note, I think it is important to remember that a significant part of the problem relates to the destruction of female bears. In my opinion, emphasis should be placed on education of the public living and working in bear country. Education programs may result in a reduction of the number of orphaned cubs.

Michael Madel

The Montana Government maintains a facility for orphaned wildlife, and subscribes to a policy which prohibits the re-release of any predator back into the wild. The moral, ethical, and management implications of re-releasing predators are significant, and not well understood.

Richard Leonard

Within Canadian national parks, all natural resources are managed under authority of the National Parks Act. However, it is important to note that the Canadian Government is presently engaged in native land claims negotiations, and that parks management may be affected once the claims are settled.

Parks Canada manages national parks under the auspices of an established policy designed and implemented to facilitate maintenance of natural ecosystems. Although the policy framework is of necessity very general, Parks Canada develops a management plan which guides the operation of each park. At the field level, personnel employ a series of Directives to meet their responsibilities. For example, field managers are required to follow a "Bear Management Directive", which addresses: bear-people conflicts, immobilization of bears, transport of problem bears, and research (e.g., experimentation with immobilization drugs and aversive conditioning).

Stephen Herrero

Research is an essential element of any management plan, particularly in view of the fact that the plan assists managers in their efforts to establish priorities. A management plan also fosters proactive (as opposed to reactive) management. A management plan can be distilled into simple directives. For example, a directive might promote the clean-up and control of garbage in the absence of catalysts such as bear-people conflicts, which may result in unnecessary human injury.

Sandi Fowler

The U.S. Park Service operates under the auspices of coordinating legislation, which has been interpreted and translated into general goals and objectives which are consistent throughout the national park system. Each Park Superintendent is required to develop a management plan to facilitate park operations. Although the management plans meet the general goals and objectives of the National Park Service, each management plan is unique and tailored (under the direction of the Park Superintendent) to meet the specific requirements of that park. In essence, each Park Superintendent uses considerable discretion in the development of management plans. Interagency cooperation is encouraged throughout the park system.

Wayne McCrory

Generally, the management of bear-people conflicts in British Columbia Provincial Parks has been an ad hoc process. Management has occurred in isolation of the "bigger picture". The British Columbia Parks Division contracted Stephen Herrero and myself to examine this question in an effort to improve their management of bear-people conflicts in provincial park areas.

Prior to development of the policy, we asked ourselves some important questions. For example, what is a policy, a directive, a procedure? How do these things interrelate, and how do they fit into the overall resource management program? We scoped our program with the answers to these questions in mind.

Alberta has pursued a program designed to minimize bear-people conflicts and to equip field managers with the decision-making powers to deal with problem bears. An important aspect of this work is the habitat evaluation program whereby recreational developments can sometimes be located away from key bear habitats. However, Alberta's program-policy fails to provide for grizzly bear preservation.

It is important to realize that ineffective management of bear-people conflicts is often a result of the failure of government to effectively manage other things, such as the location of facilities and the management of people.

Our report to the British Columbia Parks Division recommended the setting of priorities as well, such as grizzly bear population monitoring, habitat preservation, problem bear management, and the minimization of bear-people conflicts. It has emphasized avoidance of conflicts. Our program is based on the premise that effective implementation of policy can be realized only through the application of increasingly operational directives as the policy is interpreted and transmitted from senior management to the field.

Susan Bonnyman

In the Northwest Territories it is difficult to effectively implement avoidance tactics because of the geographical location of many towns, communities, and outpost camps. People have been coping with bears for a long time.

John Dalle-Molle

In Alaska many of the problems are precipitated by the mismanagement of garbage or poor food storage. In Denali National Park we have virtually eliminated garbage and food as sources of problems. But problems in and adjacent to the park occur on private land where we do not have jurisdiction. Our written bear-human conflict management plan recognizes these problems and provides for education or friendly agreements to try to solve problems. If those fail, we can file complaints with state agencies to enforce the state laws governing food and garbage attracting bears. We have also offered local landowners help in designing garbage containers and have offered help with deterring bears from sites if requested by state authorities.

Mary Meagher

In Yellowstone National Park, we strive to cooperate with authorities outside the park to control garbage in adjacent areas. The U.S. Park Service considers garbage management in and adjacent to the park a priority, and in some cases is prepared to seek implementation of garbage management through the judicial system if necessary. Our jurisdiction ceases at the boundary; other agencies or entities would be necessary for direct legal action. All possible means to induce cooperation would be used first.

Barney Smith

Information is a powerful tool in the management and prevention of bear problems, and this relates to garbage management. Individuals who learn the bear they attracted was later killed may behave more responsibly next time. And agencies looking after garbage may be more attentive if, as in our case, they learn that problem bears generate significant costs to society. In the past 8 years, problem bears have cost Yukoners $500,000 in property damage, management fees, and hospital fees. Careful reporting of bear problems and mortality is essential to the accurate dissemination of information.

Christopher Servheen

The U.S. Fish and Wildlife Service cooperates in a $15,000 reward program for information leading to the arrest and conviction of people who illegally kill a bear. We do not presently have statutory authority to require people to secure their garbage from bears on private lands where most bear-garbage conflicts occur. The circumstances which surround these incidents are often complex. We have developed Interagency Grizzly Bear Guidelines which detail our bear management and habitat management in grizzly range.

Erich Follman

Alaska is in the same situation in regard to the problems of garbage mismanagement. Some of the more northern remote villages have open, and poorly managed, dumps. Even though the state has regulations prohibiting the killing of a bear under the guise of "defence of life and property", when an attractant such as garbage precipitates the problem, manpower shortages, minimal budgets, and other wildlife issues of higher priority make proper enforcement difficult. In addition, the subsistence provisions offered to native communities further complicate the issue, when they can legally kill a polar bear even if it is attracted to a village or industrial site because of poorly disposed of garbage accumulations.

Ross Hagen

In my opinion, management agencies should strive to reach that "happy medium". I feel that this can only be accomplished through the deployment of an effective education program and appropriate regulations which can be enforced under the sponsoring legislation. In the Northwest Territories for example, we require a policy on the locating of camps and the feeding of wildlife.

Stephen Kearney

Policy is important because it commits the Department to action. It provides for the development and implementation of directives which define responsibilities (e.g., everyone knows their job) and provides guidelines for management decisions. In addition, it is important to note that policies and procedures can grow outdated. Management staff tend to evolve a complacent attitude if the incident rate is insignificant for a period of time. Therefore, policies and procedures must be reviewed and updated on a regular basis, and staff must be encouraged to maintain an attitude of vigilance with respect to the implementation of these policies. In this context, a proactive approach is critical to dynamic policy and procedure development and implementation.

Harold Werner

In Sequoia National Park, the park staff complete an annual review of operating plans and procedures. It is also important that the lines of authority be well established and that managers throughout the ranks coordinate their decision-making process.

Richard Leonard

Yes, I agree. Within the Canadian National Parks system, we have worked to identify those decisions requiring Superintendent approval and those decisions which can be made by field staff. The boundaries of the decision-making capabilities of each manager are well defined at each level of authority.

Rod Gow

I believe it is important to ensure that most of the field management decisions be made by the field managers.

Richard Leonard

In Canada, Canadian Parks Service Superintendents strive to streamline and update the management process by approving annual work plans and procedures. In addition, management directives are designed to minimize the options and decisions made by Park Officers. These directives more clearly define the role of our field staff, and provide them with authority to act in a consistent manner.

Barney Smith

The public's role in bear problem prevention is often limited to voluntary (or poorly enforced) compliance with guidelines in brochures or on nearby signs. Given the increasingly urban nature of our population, we may need to consider well advertised, and possibly compulsory, training for the urban residents or industry personnel who invade the wilderness each year.

Rod Gow

Bear-people conflict management is a double-edged sword. On the one had we have a tendency to approach our programs cautiously because of the inherent ramifications of some of our actions. On the other hand, there is a feeling that we should deal with our problems quickly and effectively as they occur.

John Dalle-Molle

If we develop and employ a technique or a facility and the public uses it, we are responsible. Problems which might emerge as the result of the operation of a facility, for example, could result in public backlash against bears. Therefore, we need to thoroughly evaluate new ideas before they are adopted.

Rod Gow

I believe the public should have access to the fruits of our research. The plastic slug is one example. I believe that government should provide the plastic slug to the public at minimal charge.

Michael Madel

Crowd control at bear-people conflict sites is a difficult problem, particularly if the incident occurs outside of a park. It often requires a cooperative effort between the wildlife authorities and the local Sheriff's office.

Mary Meagher

Yellowstone National Park has maintained a problem bear management policy for a number of years. The overall goal of the policy is to minimize bear-people conflicts. Successful implementation is contingent upon effective coordination by all management staff and an effective public education program.

Ross Hagen

In view of the fact that field staff are required to implement policies and procedures, I feel it is important that field staff be consulted during the development of any programs.

David Garshelis

All jurisdictions should be encouraged to develop and implement formal policies. In addition, each jurisdiction should endeavour to ensure that the management agencies are in fact implementing and following the policies. Policies should be designed to eliminate interdivisional problems or biases. An example of one such interdivisional problem in Minnesota concerns the lack of communication between county governments and the state Department of Natural Resources over the management of county dumps and the consequent effects on nuisance bear activity.

Paul Gray

The discussion thus far has been provocative and informative. With our discussion in mind, I would like to focus on the concept of a comprehensive policy. It seems that an effective policy should be based on legislation and interpreted through a series of practical guidelines and/or strategies. In addition to applied wildlife management, this kind of policy also affects land use planning and environmental impact assessment planning, particularly as they relate to wildlife population management strategies, habitat management strategies, people strategies, and conflict resolution strategies. They are all interconnected, and critical to the "big picture" concept introduced by Wayne McCrory.

Although crisis management has, in the past, often been the catalyst for the development of bear-people conflict strategies, we have come a long way in the last decade. The proactive approach to bear-people conflict resolution discussed by Stephen Herrero is another important point which might merit additional discussion.

Steven Nadeau

Although I agree that much management authority must rest with field staff, it is important that delegation of such authority be closely coordinated and monitored by a highly trained and experienced coordinator. For example, policy within a park subdistrict or other management unit cannot be implemented in isolation of surrounding subdistricts. Without coordination, managers have the tendency to implement unique programs which may appear to work well for their area, but in actuality are in opposition to operations in adjacent areas. Often, problems may not be alleviated, but are merely displaced, and possibly worsened.

John Dalle-Molle

In Denali National Park, the implementation of bear policies and plans is controlled by a central authority, which is held accountable for the overall program in the park. Therefore, the central authority strives to coordinate all field operations in order to meet the objectives and standards. New actions are reviewed and tested prior to parkwide implementation.

Rod Gow

It is important that a policy be sensitive to the different needs and specific requirements of districts and regions. In reality, if the policy is not sensitive to these differences, the managers and field staff will not be able to effectively implement it.

John Dalle-Molle

Accountability is an important concept in the implementation of policies and plans.

Erich Follmann

Alaska does not have a formal statewide policy concerning the management of problem bears. However, there is an unwritten policy which is followed for the most part. At first an assessment is made as to the seriousness of the problem, that is, is merely the presence of a bear the source of concern or is there a real hazard. If a hazard does not exist deterrents are attempted such as cracker shells. If serious problems exist, black bears as-a-rule are disposed of, but the sex, age, and reproductive status of grizzly/brown bears weighs heavily on their disposition. Females with and without young and young bears are generally protected, and deterrents as well as relocations are attempted to solve the problem. Grizzly bears that are subject to destruction given that the situation is considered potentially hazardous are very aggressive bears, obviously unhealthy bears, incorrigible bears including females that have been relocated 2 or more times, and bears that have caused extensive destruction. Again, these are factors considered by state biologists and protection officers when dealing with problem bears, thus allowing flexibility in any given situation.

Harold Werner

Interjurisdictional agreements are important in the successful completion of management and research programs. In Sequoia National Park, for example, radio-collared bears utilize habitat outside of the park where park staff have no authority. The National Park Service strives to work closely with adjacent jurisdictions to facilitate completion of the programs and implementation of management plans.

RECOMMENDATIONS

1. All agencies working under legislative authority should address bear-people conflict management within the context of a comprehensive policy or policies. Agencies which do not have legislative authority but which may impact on the management of bear-people conflicts should work cooperatively with the legislated authority to address issues of mutual concern.

2. The policy and associated plans and directives should be reviewed and updated at regular intervals by government agencies in consultation with the public.

3. The policy should be accurately interpreted and translated into management action with practical, explicit, and well-defined guidelines and/or directives.

4. The policy and associated plans and directives should account for the "big picture" and address wildlife population management issues, wildlife management issues, conflict resolution issues, and people management, including education and training programs.

5. The policy and associated plans and directives should promote a proactive approach to bear-people conflict management.

6. The policy should be flexible enough to facilitate cooperative development and implementation of

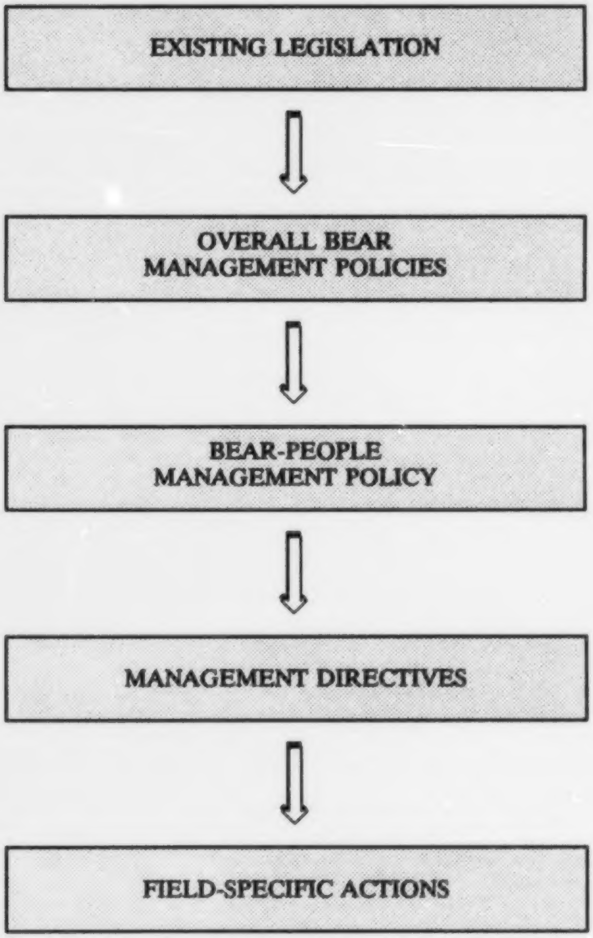
interjurisdictional management and research programs.

7. The policy and associated plans and directives should address research and management priorities.

8. The policy and associated plans and directives must be realistic and sensitive to the requirements of field managers, who are charged with the responsibility of implementing programs. Field managers should participate in the development of policies and plans in order to implement appropriate actions.

9. The policy and associated plans and directives should promote the creation of standardized data collection programs.

10. The policy and associated directives should instill accountability within the agencies responsible for the management of bear-people conflicts. The following structure describes one management system which should be considered:


EXISTING LEGISLATION
OVERALL BEAR MANAGEMENT POLICIES
BEAR-PEOPLE MANAGEMENT POLICY
MANAGEMENT DIRECTIVES
FIELD-SPECIFIC ACTIONS

WORKSHOP II · DETERRING, CAPTURING, AND HANDLING PROBLEM BEARS

SUMMARIZED BY: Peter L. Clarkson

CHAIRMAN: Peter L. Clarkson

The following is a summary of the discussions held during the workshop. Any errors or omissions are regretted. The workshop was attended by approximately 40 people including biologists, managers, wildlife and park officers, and other interested persons. The following summary has been broken into different sections which represent the main topics of discussion during the workshop. The workshop was not a comprehensive review of the topics, but rather a discussion on aspects of interest to the workshop participants.

WHEN ARE BEARS PROBLEMS?

The workshop began with a brief discussion on when a bear should be considered a problem. Some problem bear complaints received by wildlife or park officers were based on the sighting of a bear. Depending on the situation, seeing a bear may or may not be a problem. If a bear is close to a human facility or near people and is showing some interest in the area, it may be considered as a problem as the potential for a more serious encounter is possible. However, if the bear is seen in its natural habitat or travelling from one area to another and has not shown any interest in the area, it may not be considered a problem but the observation should be recorded for future reference. Given the encroachment by people on bear habitat in some areas, it will be necessary for bears and people to live in close proximity if bears are to survive.

Bears should be considered a problem when they are showing a definite interest in a facility or area of human activity. If a bear is seen over several days and appears to be coming close to a site it may be considered a problem as the bear is probably "casing" the site and will be a problem in the near future.

DETERRING BEARS

If a bear is considered to be a problem, then deterring it is one management option that should be considered. The discussion focused on three aspects: when to deter bears, what to use, and whether deterring bears has been shown to be effective. Not all problem situations will lend themselves to a deterrent attempt. In some situations, it may be too dangerous or serious to attempt deterring a bear. Bears should be deterred when possible. The best time to deter a bear was considered to be as soon as it appears to be interested in the area, and hopefully before the bear has an opportunity to receive a food reward. Attempts should be made to deter any problem bear to help condition the bear to avoid human areas.

A variety of deterrents were considered useful depending on the bear species involved, the site, and availability of deterrents. In some cases vehicles or helicopters have worked well to deter bears from an area. Other situations may require the use of a plastic or rubber slug. The recent development and testing of the 12 mm plastic slug, 38 mm rubber baton, and 25 mm bear thumper were discussed. The use of chemical repellents (red pepper) was also discussed and thought to be a possible alternative for areas where firearms are not allowed, or for people who do not wish to carry firearms. More testing of chemical repellents was considered necessary.

CAPTURING AND HANDLING PROBLEM BEARS

The technique used to capture problem bears depends on the situation and availability of management strategies. Culvert traps, leg hold snares, ground darting, and aerial darting have all been used in the past. Recent development on the culvert trap in some jurisdictions has replaced the guillotine door with a side-swinging door.

In most cases it was considered important to immobilize the bear. Many of the participants felt that the new drug Telazol was safer to use and more effective than previous drugs used on bears.

Once a bear is captured, the standard physical information on the bear should be recorded and a tooth removed for aging. Any information about the bear will help determine which bears are becoming problems.

All problem bears should be marked to help identify them in possible future problem situations. Ear tags, ear flags, and a lip tattoo were considered sufficient for marking a bear. In some special situations it may be important to radio-collar bears to determine their activity after being captured.

What to do with bears once they were captured presented another problem. Relocating problem bears has not worked in some areas as there is no place to move them to, they quickly return if relocated, or they create problems in the area that they are moved to.

CONCLUSIONS

After much discussion on management strategies to deal with problem bears, some of the participants felt that the options available were often too expensive or did not address the real problem. It was felt that more time and effort put into preventing problem bear situations would solve more problems. More communication between jurisdictions would also help to share information on how to prevent and better manage problem bears.

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